MED 577

TB MED 577

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

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OCCUPATIONAL AND ENVIRONMENTAL HEALTH

SANITARY CONTROL AND SURVEILLANCE OF FIELD WATER SUPPLIES

HEADQUARTERS, DEPARTMENT OF THE ARMY
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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON DC, *7 March, 1986*

OCCUPATIONAL AND ENVIRONMENTAL HEALTH

SANITARY CONTROL AND SURVEILLANCE OF FIELD WATER SUPPLIES

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Chapter 1

Introduction

1-1. Purpose

a. This technical bulletin provides preventive medicine (PVNTMED) information and guidance to military and civilian personnel concerned with the location, production, sanitary control, and surveillance of field water supplies on land. The sanitary control and surveillance of drinking water aboard all Army floating vessels will be accomplished as specified in TB 43-0153. Information in this bulletin is to be used by PVNTMED and water purification personnel during field training exercises and actual combat deployment to provide the best possible water for human consumption and other purposes in the field. This technical bulletin applies to the Active Army, US Army Reserve, and the Army National Guard.

b. Provisions of this publication are subject to three international agreements: Standardization Agreement (STANAG) 2136 (Minimum Standards of Water Potability), STANAG 2885 (Procedures for the Treatment, Acceptability and Provision of Potable Water in the Field), and Quadripartite Standardization Agreement (QSTAG) 245 (Minimum Requirements for Water Potability). When an amendment, revision or cancellation of this bulletin is proposed that will affect or violate the agreement concerned, the preparing activity will take proper action through international standardization channels.

c. This bulletin is in support of AR 40-5, chapter 14.

1-2. References

Required and related publications are listed in appendix A, sections I and II. Prescribed and referenced forms are listed in appendix A, sections III and IV.

1-3. Explanation of abbreviations and terms

Abbreviations and special terms used in this bulletin are explained in the glossary.

1-4. Responsibilities

The following responsibilities support the land-based water resources management in contingency operations described in AR 700-136.

a. The Surgeon General, in addition to the responsibilities cited in paragraph 3*e*, AR 700-136, will review Army publications related to the health protection of field water supplies and usage.

b. Commanders at all levels will perform responsibilities cited in paragraph 3*g*, AR 700-136.

c. The installation medical authority (IMA) will—

(1) Ensure the semiannual water trailer and tank truck inspection program is conducted for all non-table of organization and equipment (TOE) equipment (para 7-8*d*(2)).

(2) Assume the role of the command surgeon when a command does not have a TOE surgeon.

d. The command surgeon will—

(1) Inspect and approve water sources and water treatment methods and procedures (para 4*k*, AR 700-136).

(2) Approve water for distribution (para 1-4*g*(6)).

(3) Establish the frequency of water point inspections by PVNTMED personnel (paras 1-4*g*(3) and 5-7).

(4) Recommend the use of lower quality water in emergency situations (para 3-3*c*(2)).

(5) Recommend procedures to maintain the potability of water and protect the health of troops (para 4*k*, AR 700-136).

(6) Ensure the semiannual water trailer and tank truck inspection program is conducted in garrison (para 7-8*a*).

(7) Prescribe the chlorine residual required (chap 6, sec II, and para 8-2).

(8) Recommend the use of cleaned and sanitized fuel containers for potable water during extreme emergency situations (paras C-3*a* and 7-3*b*).

(9) Ensure exposed surfaces of water purification equipment and containers remain uncontaminated or are decontaminated in the event chemical or biological agents or nuclear weapons are employed on the battlefield (para 7-7 and TM 3-220, para 7*b*).

e. The logistics staff officer per paragraph 4*i*, AR 700-136, will—

(1) Coordinate water source reconnaissance activities with water purification, engineer, and PVNTMED personnel (para 4-6).

(2) Coordinate the production and distribution of adequate quantities of potable water in the field (para 5-1*a*).

(3) Determine the requirements for potable water based on operational guidance from the operations and training officer, the command surgeon, and the consumption factors listed in FM 10-52, appendix C.

f. Water purification personnel will—

(1) Conduct detailed reconnaissance for surface

water sources (para 4-6).

(2) Operate and maintain water purification equipment to ensure adequate quantity and quality of potable water (paras 5-1*a* and 6-5*a*).

(3) Use appropriate auxiliary treatment devices for removal of chemical agents (para 5-4).

(4) Dispose of contaminated treatment wastes properly (para 5-4).

(5) Conduct tests of raw and product water for chemical agents and radioactivity as necessary (para 5-9*c*(2)).

(6) Ensure that chemicals for treatment and analysis are adequately stocked and have not expired (para 5-12*b*(1)).

(7) Safeguard stored potable water from contamination (para 5-11*b*).

(8) Examine water trailers and other containers for cleanliness prior to issuing water (para 5-11*c*(3) and FM 10-52, chap 7, sec I).

(9) Ensure exposed surfaces of water purification equipment and containers remain uncontaminated or are decontaminated in the event chemical or biological agents or nuclear weapons are employed on the battlefield (para 7-7 and TM 3-220, para 7*b*).

g. Preventive medicine personnel will—

(1) Evaluate the use of lower quality water in emergency situations and advise the command surgeon of alternatives (para 3-3*c*(2)).

(2) Assist in water source reconnaissance and test raw water sources to determine suitability for treatment by water purification units (paras 4-5, 4-6, and 4-8*c*).

(3) Perform periodic inspections of each water point (para 5-7*a* and 5-13).

(4) Test treated water to ensure water quality standards are being met (para 5-13*a*).

(5) Conduct bacteriological testing (para 5-13*a*(11)).

(6) Report results of water quality testing and surveillance activities to the command surgeon for approving water for distribution (para 5-7).

(7) Inspect potable water treatment, storage, and distribution equipment (chap 5, sec II, and chap 7, sec II).

(8) Monitor chlorine residual (para 6-3).

(9) Conduct a semiannual water trailer and tanker inspection program in garrison (para 7-8).

(10) Inspect field shower points and personnel decontamination stations (paras 8-8 through 8-12).

(11) Train and evaluate unit field sanitation teams as specified in TC 8-3 and FM 21-10, appendix A.

h. The unit commander, per paragraph 4*l*, AR 700-136, will—

(1) Enforce water management (para 2-4).

(2) Provide members of the command with the required amount of safe drinking water (AR 700-136, para 4*l*(3)).

(3) Ensure that all personnel are drinking adequate amounts of water considering the environmental conditions and level of activity per FM 21-10, chapter 3.

(4) Ensure that all personnel understand the dangers of drinking unsafe water (para 6-1).

(5) Appoint and use a field sanitation team per AR 40-5, chapter 14 (para 6-3*a*).

(6) Ensure the field sanitation team has been trained and can perform their duties per TC 8-3 and FM 21-10.

(7) Ensure an adequate supply of field sanitation team materials exists as per AR 40-5, chapter 14.

(8) Ensure the continued disinfection of potable water in the field per FM 21-10, appendix A, task 5.

(9) Request approval to use alternative containers under emergency conditions (para 7-3*b*).

i. The unit field sanitation team will—

(1) Coordinate mess sanitation, field waste disposal, and personal hygiene to prevent the spread of waterborne diseases (para 6-3*a*).

(2) Check the unit supply for chlorine residual two times a day or at frequent intervals to ensure adequate residual per FM 21-10, appendix A, task 5 (para 6-3*b*).

(3) Chlorinate unit water supplies per FM 21-10, appendix A, task 6.

(4) Provide advice on protection of water trailers and other containers from heat to keep the water as cool as possible in hot regions and from cold to keep it from freezing in cold regions (para 6-3*b*(5)).

(5) Maintain adequate stocks of iodine tablets and chlorination kit supplies per AR 40-5, chapter 14 (para 6-3*b*(4)).

(6) Ensure exposed surfaces of water containers remain uncontaminated or are decontaminated in the event chemical or biological agents or nuclear weapons are employed on the battlefield (para 7-7, and TM 3-220, para 7*b*).

(7) Ensure all potable water containers (trailers, drums, Lyster bags, and cans) are maintained in a clean and sanitized condition (para 7-5).

(8) Inspect water containers on a quarterly basis per FM 21-10, appendix A, task 4.

(9) Instruct unit personnel in the proper use of individual water purification tablets and other emergency water treatment techniques per FM 21-10, chapter 2, section IV.

j. Bath unit and personnel decontamination station operators will—

(1) Request assistance from PVNTMED personnel to conduct sanitary surveys of potential shower and decontamination water sources when the presence of infectious disease-producing organisms is suspected

(para 8-3).

(2) Operate and maintain their equipment to ensure the health of the troops (paras 8-1, 8-2, and 8-3).

(3) Use appropriate auxiliary treatment devices for disinfection and removal of disease-producing organisms (paras 8-1, 8-2, and 8-3).

(4) Dispose of shower wastewater and contaminated treatment wastes properly (para 8-4 and TM 3-220, para 20*d*(3)).

1-5. Technical assistance

a. General. Requests for technical assistance should be forwarded through command channels.

b. Continental United States (CONUS). Requests should be addressed to the Commander, U.S. Army Environmental Hygiene Agency (USAEHA), Aberdeen Proving Ground, MD 21010-5422, with a copy furnished to Commander, U.S. Army Health Services Command, ATTN: HSCL-P, Fort Sam Houston, TX 78234-6000.

c. Outside Continental United States (OCONUS). Requests from the—

(1) U.S. Army Europe and Seventh Army areas of responsibility will be forwarded to Commander, 7th Medical Command, ATTN: AEMPS-PM, APO New York 09102.

(2) U.S. Army Western Command, U.S. Army, Japan, and Eighth U.S. Army areas of responsibility will be forwarded to Commander, U.S. Army Pacific Environmental Health Engineering Agency—Sagami, APO San Francisco 96343.

(3) U.S. Army South areas of responsibility will be forwarded to Commander, U.S. Army South, ATTN: Surgeon, APO Miami 34004.

Chapter 2

Human Requirements for Potable Water

2-1. General

Few environmental factors impact more on individual or unit well-being than the availability of an adequate and safe potable water supply. Required water consumption to prevent dehydration and promote physical and mental welfare varies with the climate, environment, and level of physical activity. Additional information is given in TB MED 81; TB MED 507; FM 10-52-1, chapter 4; and FM 21-10, chapters 2 and 3.

2-2. Potability versus palatability

a. Potable water. One way that water may be classified is by how fit it is for drinking. Potable water is free from disease-producing organisms, poisonous substances, and chemical or biological agents and radioactive contaminants which make it unfit for human consumption and many other uses. Potable water may or may not be palatable.

b. Palatable water.

(1) Palatable water is pleasing in appearance and taste. It is significantly free from color, turbidity, taste, and odor. Also it is cool and aerated. Palatable water may not be potable.

(2) Tempering the water to the optimum temperature of 60 °F plus or minus 10 °F (16 °C plus or minus 5 °C) can be accomplished by shading containers or mechanically chilling or heating.

(3) Flavoring aids can mask unpleasant tastes or odors in water.

2-3. Water planning factors

Personnel who fight or work in the field need water to sustain their abilities. The amount of water necessary to remain combat effective varies with the climate and the season. Water planning factors for the development of logistic support requirements are presented in FM 10-52, appendix C.

2-4. Water management

a. The using unit commander will enforce water management. *In hot climates* water management includes ensuring that troops drink adequate amounts of water to prevent dehydration and heat casualties. *In areas where water supplies are scarce,* water management includes equal rationing to all personnel and giving priority to consumption over other uses such as laundry or showers. *In areas where water is not limited,* water management includes minimizing waste which, if not controlled, could form insect breeding areas.

b. Water conservation, recycling, and reuse are discussed in chapter 9.

2-5. Body water loss

The healthy human body loses water by urinating, breathing, and sweating. An individual subjected to high heat stress may lose water in excess of 1 quart (1 liter) per hour by sweating. The sweat loss must be replaced to ensure combat effectiveness. Sustained dehydration can result in heat stress; deterioration of performance; and, if left untreated, ultimately death.

2-6. Water replacement

The preferred method of water replacement is taking small amounts of water throughout the work period. During a period of moderate activity with moderate environmental conditions prevailing, the water requirement is 0.5 quart (0.5 liter) or more per hour per person and is best taken at 20- to 30-minute intervals. As activities or conditions become more severe, the intake should be increased accordingly. The table in FM 21-10, chapter 3, section I, shows how heat condition information can determine required water intake and work/rest cycles. The unit commander will provide the required amount of safe drinking water. When sufficient quantities do not exist, modify work/rest cycles to prevent dehydation.

Chapter 3

Field Water Quality Standards

3-1. Development of standards

Field water quality standards have been developed by international agreements among the North Atlantic Treaty Organization (NATO) Forces and the Quadripartite Armies. These organizations have agreed, when operating on land, to adopt minimum requirements for potability of drinking water to be issued to troops in combat zones or in any other strict emergency situations. The NATO STANAG 2136 provides guidance on short term (1 to 7 days) standards under these conditions while the QSTAG 245 provides guidance on both short-term and long-term (greater than 7 days) standards. As a member of both organizations, the United States has agreed to accept and provide water meeting these standards when participating in mutual logistical water support under these field conditions.

3-2. Consumptive uses

a. Rationale. Field water quality standards provide for the safety of the exposed population based on the anticipated duration of consumption and the overall health of the population. Some of these standards were also developed to produce an aesthetically pleasing water. These standards vary depending on the anticipated duration of use and the quantity of water consumed.

b. Standards.

(1) Emergency situations. No standards apply when personnel are cut off from supply lines and treated water is not available from quartermaster supplies. Each individual should select the clearest, cleanest water with the least odor and then treat the water using individual water purification procedures. Such procedures are limited to disinfection using iodine tablets, chlorine ampules, or boiling (FM 21-10, chapter 2, section IV).

(2) Short-term consumption.

(a) The standards in table 3-1 apply to units operating for 7 consecutive days or less when the commander, upon medical advice, determines that a field operational condition exists which prevents troop access to drinking water meeting long-term consumption standards. The commander imposing the short-term consumption standards must accept potential troop performance degradation, increased incidence of disease, casualties from toxic substances, and reduced combat efficiency with each day the imposition remains in effect. These units would rely on water treatment by man-portable water purification devices, if available, or by individual water purification procedures specified in *(1)* above.

(b) Untreated water sources should be tested for compliance with the standards in table 3-1. Unit personnel should use the M272 Water Testing Kit (NSN 6665-01-134-0885) if chemical warfare is suspected in their operating area. (TM 3-6665-319-10.)

(3) Long-term consumption. The standards in table 3-2 apply to all situations more than 7 days where treated water is produced by water purification units.

Table 3-1. Water quality standards for short-term consumption (7 consecutive days or less)

Constituent	Standard (maximum acceptable limit)
PHYSICAL:	
Turbidity	Reasonably clear
CHEMICAL:	
Arsenic	2.0 mg/L
Cyanide	20.0 mg/L
BACTERIOLOGICAL:	
Coliforms (as measured with the membrane filter technique)	1.0 per 100 mL
CHEMICAL AGENTS:	
Hydrogen cyanide	20.0 mg/L
Lewisite	2.0 mg/L
Mustard	0.2 mg/L
Nerve agents	0.02 mg/L
RADIOLOGICAL	There are no concrete radiological standards. It has been assumed that water is suitable for drinking if personnel can occupy the area around the water source for a week or less without adverse physiological effect.

Table 3-2. Water quality standards for long-term consumption (more than 7 days)

Constituent	Standard (maximum acceptable limit)
PHYSICAL:	
Color	50 units
Turbidity	5 NTU
CHEMICAL:	
Arsenic	0.2 mg/L
Chloride	600.0 mg/L
Cyanide	2.0 mg/L
Magnesium	150.0 mg/L
pH	5.0-9.0 units
Sulfate	400.0 mg/L
Total dissolved solids	1500.0 mg/L
BACTERIOLOGICAL:	
Coliform organisms (as measured with the membrane filter technique)	1.0 per 100 mL
CHEMICAL AGENTS:	
Hydrogen cyanide	2.0 mg/L
Lewisite	0.2 mg/L
Mustard	0.05 mg/L
Nerve agents	There is not yet enough data to set a practical long-term standard.
RADIOLOGICAL	There are no concrete radiological standards. There is not yet enough data to set a practical long-term standard.

3-3. Nonconsumptive uses

a. Rationale. The standards in table 3-3 were established to protect troops from contracting diseases from water that comes in contact with their skin or are incidentally inhaled or ingested in small amounts. The standards were also designed to protect equipment and clothing from deterioration.

b. Standards. Water quality standards for nonconsumptive uses are presented in table 3-3.

c. Variances from water quality standards.

(1) Water of the next higher quality may be used for any of the purposes listed in table 3-3 when water conservation considerations permit.

(2) *Water of the next lower quality will not be used unless an emergency exists.* The PVNTMED personnel will evaluate the situation and provide alternatives to the command surgeon. The command surgeon will recommend the use of lower quality water.

Table 3-3. Water quality standards for nonconsumptive uses

Water quality	Uses include
Potable water	*a.* Mess operations such as food washing. *b.* Personal hygiene such as shaving, brushing teeth, helmet baths, and comfort cooling. *c.* Medical treatment. *d.* Photo processing for quality control. *e.* Ice production for food preservation and cooling. *f.* Water hose and pipeline testing and flushing.
Disinfected nonpotable fresh water	*a.* Centralized hygiene such as field showers. *b.* Decontamination of personnel. *c.* Retrograde cargo washing. *d.* Heat casualty body cooling. *e.* Graves registration personnel sanitation. *f.* Well development.
Nonpotable fresh water	*a.* Vehicle coolant. *b.* Aircraft washing. *c.* Pest control. *d.* Field laundry. *e.* Concrete construction. *f.* Well drilling.
Seawater	*a.* Vehicle washing.* *b.* Electrical grounding. *c.* Fire fighting. *d.* Nuclear, biological, and chemical (NBC) decontamination of materiel. *e.* Road construction.

*Seawater may lead to significant corrosion of some mechanical parts. Consider nonpotable fresh water if available.

(3) Only potable water will be used for showering, bathing, or other bodily contact in areas—

(*a*) Where diseases such as schistosomiasis and leptospirosis are endemic and prevalent.

(*b*) When chemical agents may be present.

Chapter 4

Water Sources and Water Point Reconnaissance

Section I. Water Sources

4-1. General

Water may be derived from surface or ground water sources including existing facilities. Surface water sources are easy to develop but are very susceptible to pollution and chemical agent contamination. Ground water sources are less likely to be contaminated, but require special well drilling equipment and more time for development. Existing facilities that have been damaged can be repaired or modified for use. This chapter provides background material to assist PVNTMED personnel in evaluating the available water sources.

4-2. Surface water

Surface water sources are classified as fresh, brackish, or salt water (seawater) depending on the concentration of total dissolved solids (TDS). Fresh water has a TDS concentration of less than 1,500 ppm. Brackish waters are high in minerals and have a TDS concentration between 1,500 ppm and 15,000 ppm. Salt waters have a TDS concentration greater than 15,000 ppm.

4-3. Ground water

Generally, ground water has less chemical or biological contaminants than surface water, provided reasonable care is exercised in the selection of a drill site. Harmful microorganisms are usually reduced to tolerable levels by filtration through the soil. Ground water rarely requires treatment other than disinfection, unless its TDS content is greater than 1,500 ppm.

4-4. Existing water facilities

In some circumstances existing water facilities can be put to use with less expenditure of time, effort, and equipment than it would take to develop a new field source. All water produced from existing facilities will be considered unsafe until evaluated by PVNTMED personnel and determined potable by the command surgeon.

4-5. Nonpotable water sources

All water sources which have not been tested by PVNTMED personnel and approved by the command surgeon as potable will be labeled with a sign that reads: NONPOTABLE WATER. DO NOT DRINK. This sign will be posted at a nonpotable water source by the PVNTMED personnel or unit conducting operations. Such sources include construction water points, untested faucets, cisterns, vehicle washing supplies, etc. After the command surgeon has approved the source as potable, only PVNTMED personnel may remove the posted sign.

Section II. Water Point Reconnaissance

4-6. General

Surface water source reconnaissance will be accomplished by water purification personnel. Ground water and seawater source reconnaissance will be accomplished by engineer personnel. Such reconnaissance is coordinated by the logistics staff officer. A member of the PVNTMED section or detachment will be included in the reconnaissance mission to inspect and test untreated water sources for suitability. A detailed description of reconnaissance activities is presented in FM 10-52, chapter 3.

4-7. Site examinations

The proposed site and an area upstream within 2 miles (3.2 km) of the site will be examined for sources of pollution and evidence of contamination. Water purification units should not be located near areas where—

a. Sources of pollution include landfills, agricultural and livestock wastes, industrial and domestic sewage discharges, and fuel oil storage sites.

b. Evidence of contamination includes dead fish or vegetation, excessive algae growth, oil slicks, and sludge deposits.

4-8. Water testing requirements

a. Required water source tests. Several water source tests will be made to determine if the source water can be made potable by Army water purification units. These tests and the kits used to perform them are listed in table 4-1.

b. Additional water source tests. Additional water source quality tests may be necessary in areas where various types of organic chemicals, heavy metals, or other contaminants are evident or suspected. Such

Table 4-1. Required water source tests and appropriate kits

Test	Kit
PHYSICAL AND CHEMICAL CONSTITUENTS:	Water Quality Analysis Sets, Preventive Medicine (WQAS-PM) and Engineer (WQAS-E) (TM 5-6630-215-12)
Chloride	WQAS-PM and WQAS-E
Chlorine demand	WQAS-E
Color	WQAS-E
Hardness, total	WQAS-E
Magnesium	WQAS-E
pH	WQAS-E
Sulfate	WQAS-E
Total dissolved solids	WQAS-E
Turbidity	WQAS-E
BACTERIOLOGICAL:	Water Testing Kit—
Coliforms	Bacteriological (TM 5-6630-215-12)
CHEMICAL AGENTS:	Water Testing Kit—
Cyanide	Chemical Agents (M272)
Lewisite	(TM 3-6665-319-10)
Mustard	
Nerve	
RADIOLOGICAL CONTAMINANTS:	Radiac Set, AN/PDR-27
Gross beta activity	(TM 11-6665-209-10 and TM 11-6665-230-12)

contaminants include pesticides, herbicides, hazardous waste, oil or fuel products, etc. Since the field water testing kits listed in table 4-1 do not have the capability to analyze for such contaminants, assistance must be requested for laboratory support. Requests for support are normally directed through the appropriate command channels of the requester to the appropriate Army laboratory or agency listed in appendix B. The request should include the location, type of analysis necessary, number of samples, estimated sampling date, and information about the requester to include unit, location, phone number, and point of contact.

c. Report requirements. The test results are recorded on DA Form 1712-R (Water Reconnaissance Report). Refer to FM 10-52, chapter 3, for use of this form. The PVNTMED section or detachment representative will enter a recommendation in block 10, DA Form 1712-R, regarding the suitability of the site for use. This recommendation will include the type of treatment required based upon the quality of the water source. The maximum allowable water source constituents for water purification units are presented in table 4-2. The chief of the reconnaissance team will send the report to the logistics staff officer. The PVNTMED section or detachment will retain a copy for use during subsequent inspections of the water point. A copy also will be sent to the command surgeon for review. Test data recorded on the DA Form 1712-R can be used as baseline data. Subsequent test results can be compared to determine if water conditions change.

Table 4-2. Maximum allowable water source constituents for Army water purification units

Constituent	Type of water purification units	
	Erdlator	ROWPU
PHYSICAL AND CHEMICAL:		
Chloride	600 mg/L	30,000 mg/L
Chlorine demand	No limit	No limit
Color	No limit	No limit
Hardness, total	250 mg/L	No limit
Magnesium	150 mg/L	No limit
pH	3-11 units	4-10 units
Sulfate	400 mg/L	No limit
Total dissolved solids	1,500 mg/L	55,000 mg/L
Tubidity	No limit	150 NTU
BACTERIOLOGICAL:		
Coliforms (as measured with the membrane filter technique)	$1X10^6$ per 100 mL	$1X10^6$ per 100 mL

Table 4-2. Maximum allowable water source constituents for Army water purification units—Continued

Constituent	Type of water purification units	
	Erdlator	ROWPU
CHEMICAL AGENTS:	Note. If the chemical agent concentrations exceed these levels, the raw water must be processed through the Water Pretreatment Decontamination Set (C & B Agents), NSN 4610-00-880-0278, before Erdlator treatment.	
Cyanide	2.0 mg/L	20 mg/L
Lewisite	0.2 mg/L	20 mg/L
Mustard	2.0 mg/L	20 mg/L
Nerve	0.02 mg/L	20 mg/L
RADIOLOGICAL:		
Gross beta activity	1000 pci/L	100,000 pci/L

Chapter 5

Water Purification

Section I. Purification Equipment and Special Procedures

5–1. General

a. Operations. All water purification equipment is operated and maintained by water purification personnel as part of combat service support. The logistics staff officer will coordinate the production and distribution of adequate quantities of potable water.

b. Equipment. Water is treated to remove sufficient contaminants to yield the best quality of water, recognizing a number of factors including the number of persons served, quality of raw water, length of time using the supply, and treatment available. The major types of water treatment equipment used by water purification personnel are the Erdlator, the reverse osmosis water purification unit (ROWPU), and water pretreatment decontamination set. A description of water treatment equipment available in the Army system is contained in FM 10-52, chapter 5, and in the operator's manual for each item of equipment (see app A).

5–2. Erdlator units

The Erdlator can provide potable water from only fresh water sources and, with augmentation, can remove conventional chemical and biological contamination. Processes used are coagulation/flocculation, sedimentation, filtration, and chlorination. Erdlator types include the 420 gallons per hour (gph) pallet-mounted unit and the 1,500 gph and 3,000 gph truck-mounted units.

5–3. Reverse osmosis water purification units

The ROWPU can provide potable water from any fresh, brackish, or salt water source and can remove chemical, biological, and radiological contamination. Treatment processes used are chemical pretreatment, filtration, reverse osmosis, and chlorination. The ROWPU types include the 600 gph trailer-mounted unit, the 3,000 gph semitrailer-mounted unit, the 150,000 gallons per day (gpd) skid-mounted unit, and the 300,000 gpd water purification barge.

5–4. Chemical agent treatment equipment

The water pretreatment decontamination set destroys chemical agents in water before processing in the Erdlator unit. It consists of a two-stage process with chemical oxidation followed by carbon adsorption. Water purification personnel will use this set when positive test results are produced by raw water samples analyzed by the M272 Water Testing Kit (NSN 6665-01-134-0885). Wastes produced from this pretreatment set will be lagooned or buried, and the area marked with the type of waste and date. Under peacetime conditions chemical agent and simulant wastes must be handled according to appropriate regulations in the Toxic Substances Control Act. After use, the set must be decontaminated by circulating a 100 ppm chlorine solution through this equipment for 1 hour and then draining the solution to waste. A further discussion of treatment method for chemical agent contamination is presented in FM 10-52, chapter 6.

5–5. Special procedures

a. Waste disposal.

(1) Environmental considerations. According to AR 200-1, paragraph 3-5*b*(1), the U.S. Environmental Protection Agency (EPA) or a State may require a discharge permit for field water purification units. Commanders with field water purification units participating in field training exercises in the United States or its possessions will coordinate with the installation facility engineer's environmental officer to determine how to dispose of wastewater and other treatment wastes. The environmental officer can assist the commander in securing a discharge permit if it is required. Outside the continental United States, commanders will coordinate wastewater disposal with the environmental agency in the host country.

(2) Procedures.

(a) Regulated discharges. In cases where a discharge permit has been secured, the water purification section chief will comply with the permit to prevent contamination of the receiving water body. In cases where a permit has been denied, the section chief should contact the environmental officer of the installation to determine if wastewater could be discharged into a sanitary manhole. Such action should also involve coordination with the chief of the wastewater treatment plant.

(b) Unregulated discharges. Even when a discharge permit is not required, the section chief should still take precautions to avoid contaminating a

receiving body of water which may be needed somewhere downstream or along the shore for a water source for another activity. Wastewater should be discharged at least 25 yards (23 meters) away from the raw water intake and downstream for flowing sources or downwind for standing bodies of water. Filter backwash water and sludges should be discharged into sumps to prevent gross contamination of the water source. When the unit vacates the area, sumps will be closed out and properly marked to include the closing date and type of waste.

(3) *Technical assistance.* Requests for technical assistance in disposing of wastewater should be referred to the appropriate Army agency or laboratory listed in appendix B.

b. Emergency purification. During emergencies in contingency operations when resupply cannot be effected through regular channels, several commercially available chemicals may be substituted for standard water purification chemicals. The use of any of these substitutes first should be approved by the chemical staff officer. Prior to using any of these substitutes, contact the staff logistics officer to inquire if any other units have extra supplies of authorized water purification chemicals.

(1) *Chlorine.* Commercial HTH, available at swimming pool supply stores, is the same calcium hypochlorite the Army uses and has 70 percent available chlorine. Household bleach is sodium hypochlorite and has 5 percent available chlorine. Instructions for using these chemicals are presented in FM 10-52, appendix E.

(2) *Lime.* Lime, also known as calcium hydroxide, can be purchased in bags of various sizes from a garden supply store.

(3) *Diatomaceous earth.* This chemical is usually available from a swimming pool supply store in cardboard drums.

(4) *Activated carbon.* Regular charcoal, when finely crushed, can serve as a substitute for activated carbon. Most grocery stores have charcoal; if not, simply use charcoal from a wood fire. Use 2 pounds of charcoal for each 5 gallons of water.

(5) *Soda ash.* Soda ash, also known as sodium carbonate, is used for chemical agent decontamination. It can be procured at swimming pool supply stores. If sodium carbonate is unavailable, a suitable substitute is baking soda, known as sodium bicarbonate, which can be found in grocery stores. Use 1 ounce of baking soda for each 5 gallons of water. If sodium carbonate is unavailable, use potassium carbonate (also known as potash) which is available in garden supply stores. Chemical dosages for potash are similar to those for soda ash. As a last resort, use the fine white ash from a wood fire. Simply add 2 ounces of wood ash to each 5 gallons of water.

(6) *Alum.* An effective substitute for alum, known as aluminum sulfate, is the baking powder found in grocery stores. Use 3 ounces of baking powder for each 5 gallons of water.

Section II. Preventive Medicine Inspection Program

5-6. Garrison inspections

If equipment and personnel cannot be inspected in the field, they will be inspected semiannually in the operating mode in garrison. Personnel from PVNTMED sections and detachments should maintain a liaison with water purification teams and should provide cooperative training on water quality analysis sets and kits.

5-7. Field inspections

a. Inspection requirement. The PVNTMED section or detachment will perform periodic inspections of each water point to ensure the sanitary condition and potability of the water. Inspection criteria are given in section III. The water point team chief will accompany the PVNTMED inspector to answer questions and note any deficiencies or problems.

b. Report requirements.

(1) Inspection findings and water sample analytical results will be recorded on DA Form 5456-R (Water Point Inspection). Local reproduction of this form is authorized on 8½- by 11-inch paper. (DA Form 5456-R is located at the end of this publication.)

(2) The original report is retained by the PVNTMED section or detachment and one copy is left with the inspected unit. Copies are also sent to the command surgeon and to the headquarters of the unit producing the water.

Section III. Preventive Medicine Inspection Criteria

5-8. General

The inspection criteria listed in paragraphs 5-9 through 5-13 are applicable to all types of water purification units and include site conditions around the water point. These criteria ensure production of potable water. The water purification personnel operating the equipment are responsible for prompt corrections of any deficiencies noted in the PVNTMED inspection.

5-9. Site conditions

a. Development.

(1) Drainage should be provided to prevent ponding at filling points.

(2) Dust control measures should be practiced to prevent dustborne bacteria from contaminating water and equipment.

(3) Rodent and insect breeding areas should be controlled to prevent the spread of disease to team members and other personnel.

b. Bivouac area.

(1) The area will be located at least 100 feet (30 m) downgradient from a well or downstream from a surface water point.

(2) FM 21-10, appendix A, task 7, recommends—

(a) Latrines will be located at least 100 yards (91 m) downstream or downgradient from the water point; and properly constructed and maintained.

(b) Handwashing devices be supplied with soap and water.

(c) Garbage and trash be properly stored and disposed of.

c. Water source.

(1) No pollution sources should exist nearer than 2 miles (3.2 km) upstream or upgradient from the water point.

(2) Tests for chemical and radioactivity (table 4-1) will be conducted by water purification personnel. The frequency of tests is related to mission-oriented protection posture (MOPP) conditions as shown in table 5-1.

5-10. Equipment

a. Intake line.

(1) Intake strainer should be attached to intake.

(2) Float and anchor should hold intake at least 4 inches (10 cm) from the surface or bottom.

b. Effluent line.

(1) Backwash water sump should be present.

(2) Sludge sump should be present (if necessary).

(3) Effluent discharges should be at least 25 yards (23 m) from intake and downstream for flowing surface sources.

c. Erdlator.

(1) Trailer/truck body should be level.

(2) Coagulator weir should be level to ensure coagulation and sedimentation occurs evenly.

(3) Correct influent/effluent pressures for the diatomaceous earth filter(s) should be maintained.

(4) Grounding should be used.

d. ROWPU.

(1) Trailer or pallets should be level.

(2) Filter backwash tank should be filled with brine.

(3) Grounding should be used.

(4) Separate storage tanks should be used for raw water and brine water, if raw water storage is necessary.

e. Generator.

(1) Grounding should be used.

(2) Fire extinguisher should be present.

(3) Operators should use hearing protection within 50 feet (15 m).

(4) Ventilation should be sufficient to prevent carbon monoxide intoxication.

f. Operator protective equipment. An operator should wear rubber hip boots and long rubber gloves when working in water or with wastewater in areas where—

(1) Diseases such as schistosomiasis and leptospirosis are endemic or prevalent.

(2) Chemical agents are likely.

5-11. Monitoring, storage, and distribution of treated water

a. Water Monitoring (operator).

(1) Water Quality Analysis Set—Engineer (WQAS-E) (NSN 6630-00-140-7820) should not contain expired chemicals.

(2) The WQAS-E tests will be conducted on the water source and treated water by water purification personnel for color, chloride, hardness (total), magnesium, pH, sulfate, TDS, and turbidity. The water source will also be tested for chlorine demand. Field tests should occur as frequently as is necessary to ensure proper equipment performance, water potability prior to issue, and detection of significant changes in source water quality which could affect equipment operations. Tests for chemical agents in water should be performed as noted in paragraph 5-9c(2).

(3) Water purification chemical usage will be

Table 5-1. Frequency of tests for chemical agents

Threat level	MOPP	Test frequency
No known threat	—	Weekly
Slight threat	1	Daily
Medium threat	2	Twice daily
Severe threat	3	Four times daily
Imminent threat	4	Hourly
Known contamination	—	Hourly and before issue of each batch of water

reported on DA Form 1713-R or DA Form 1713-1-R, as appropriate.

(4) Readings of equipment gauges and meters will be recorded on DA Form 1713-R and DA Form 1713-1-R, as appropriate.

(5) Chlorine residuals of treated water will be checked at least every hour.

(6) Water Testing Kit—Chemical Agents (M272) (NSN 6665-01-134-0885) should contain sufficient analysis materials for a 1-day testing at MOPP 4.

b. Water storage.

(1) Tanks will be level.

(2) Safety bottom apron will be placed under tanks.

(3) Open top tanks will be covered.

(4) Tanks will be maintained in a sanitary condition.

(5) Capacity should be sufficient to support issue operations.

c. Water distribution.

(1) Standpipe hoses should be at least 4 feet (1.2 m) above ground surface to prevent contamination.

(2) Hose nozzles will be clean and kept off the ground.

(3) Operators will check water container interiors for cleanliness prior to filling them. See appendix C for equipment cleaning and sanitizing guidance.

5-12. Recordkeeping and supply storage

a. Records.

(1) The following forms will be completed per FM 10-52, chapter 7:

(*a*) DA Form 1713-R (Daily Water Production Log—Erdlator), *or*

(*b*) DA Form 1713-1-R (Daily Water Production Log—ROWPU), *and*

(*c*) DA Form 1714-R (Daily Water Distribution Log).

(2) Blank forms on hand should be sufficient for the anticipated duration of operations or until resupply can be effected.

b. Supply storage.

(1) Fuel and chemicals on hand should be sufficient for the anticipated duration of operations or until resupply can be effected.

(2) Chemical containers will be labeled properly, capped tightly, and kept dry.

(3) Activated carbon and calcium hypochlorite will be stored separately to prevent mixing which could result in a violent reaction.

5-13. Product water samples

a. The PVNTMED inspector will collect treated water samples from each water point. These samples will be analyzed for the following constituents:

(1) Chloride.

(2) Chlorine residual.

(3) Color.

(4) Hardness (magnesium). (The magnesium hardness in mg/L is found by subtracting the calcium hardness value (in mg/L) from the total hardness value (in mg/L).

(5) pH.

(6) Sulfate.

(7) Total dissolved solids.

(8) Turbidity.

(9) Chemical agents.

(10) Radioactivity.

(11) Coliforms. (Note. Since this test requires 24 hours for incubation, use DD Form 686 (Bacteriological Examination of Water) to report results.)

b. The concentrations of these constituents with the exception of chlorine residual will not exceed the standards in table 3-2. If the concentration of one or more of these constituents exceeds the applicable standard, the PVNTMED inspector should take the following actions:

(1) Verify the result and immediately notify the water purification section team chief of the problem.

(2) Suggest possible ways to correct the problem.

(3) Resample the product water after corrections have been implemented.

(4) If the problem is not resolved, notify the command surgeon of the problem immediately.

(5) Review the daily water production log for units that received nonacceptable water and take followup and/or corrective action if necessary.

c. The chlorine residual will be maintained at 5 ppm under normal conditions or at a higher level if prescribed by the command surgeon.

Chapter 6

Disinfection

Section I. Waterborne Diseases

6–1. General

Potable water supplies will be disinfected because no other treatment process or combination of processes that excludes disinfection will reliably remove disease-producing organisms from water. The unit commander will instruct individuals not to drink unapproved water which could cause disease.

6–2. Causes and development of waterborne diseases

a. Types of diseases. The principle diseases contracted by humans from ingesting contaminated water are diarrheal disorders due to certain E. coli which produce toxins, salmonellosis, shigellosis, cholera, amebiasis, giardiasis, and several others. Infectious hepatitis and typhoid fever are nondiarrheal infections which can be waterborne. Schistosomiasis and leptospirosis, also waterborne diseases, principally occur from walking, working, or bathing in contaminated water. A further discussion of waterborne diseases is in appendix D.

b. Onset of symptoms. A waterborne disease rarely produces symptoms in its victims immediately after drinking contaminated water. A period of time known as the incubation period must pass before the victim comes down with the disease. During this incubation period the disease organisms are growing and multiplying within the host. Therefore, an absence of symptoms for several days after drinking untreated water is no guarantee that the water is safe. The absence of disease among the local inhabitants is also no assurance of safety, because they may have developed immunity.

6–3. Control of waterborne diseases

a. General. Control of waterborne diseases requires command emphasis to implement preventive measures by units and individuals. The unit field sanitation team, when properly trained, provides the commander with the PVNTMED expertise to accomplish the PVNTMED countermeasures listed in *b* below and in FM 21-10.

b. Preventive medicine countermeasure for drinking water.

(1) Safeguard supplies from contamination.

(2) Check unit water supply for chlorine residual two times a day or at frequent intervals to ensure adequate residual in water trailers and other unit water containers.

(3) Maintain chlorine residuals at or above 5 ppm or at the level prescribed by the command surgeon.

(4) Maintain adequate stocks of iodine tablets and chlorination kit supplies.

(5) Provide advice on protection of water trailers and other containers from heat to keep water as cool as possible in hot regions and from cold to prevent freezing in cold regions. In hot regions, water containers can be shaded using tents, shelter halves or tarpaulins, or by using a small mobile water chiller. In cold regions, water containers can be kept warm by enclosing them in heated shelters or within heated vehicles. In addition, 5-gallon water cans can be placed within an insulating jacket (NSN 7240-01-119-4956) for both hot and cold regions.

c. Water purification personnel. Water purification personnel will wear rubber hip boots and long rubber gloves when working with or in water known or suspected to contain schistosomes. Similar precautions will be observed when handling filter backwash water.

Section II. Chlorination

6–4. Chlorine disinfection

a. General. Chlorination will be used for disinfection of potable water in all cases with the exception of individual or small unit water purification for which iodine tablets may be used.

b. Efficiency. The efficiency of chlorine disinfection is affected by the following variables—

(1) *A combination of the form of chlorine present, the pH of the water, and the contact time.* As the pH of the water increases from 5 to 9, the form of the chlorine residual changes from hypochlorous acid (HOCl) (the most effective form) to hypochlorite ion (OCl^-) which is less effective. The most effective disinfection occurs when the pH is between 5.5 and 6.5. At the same pH, a longer contact time also results in increased disinfection.

(2) *The type and density of organisms present (virus, bacteria, protozoa, helminth, or others) and their resistivity to chlorine.* Bacteria are the most susceptible to chlorine disinfection whereas the cysts of the protozoa *Entamoeba histolytica* and *Giardia lamblia* are the most resistant.

(3) *The temperature of the water.* At lower temperatures microorganism kill tends to be slower, and higher chlorine residuals or longer contact times are needed.

(4) *The concentration of substances other than disease-producing organisms that exert a chlorine demand.* During disinfection, chlorine demand can be exerted by chemical compounds such as those containing ammonia and organic material. Many of these compounds are not effectively removed in conventional water treatment processes and may be present to exert chlorine demand during disinfection.

(5) *Adequate mixing of chlorine and chlorine demanding substances.* The disinfecting agent must be well dispersed and thoroughly mixed to ensure that all of the disease-producing organisms come in contact with the chlorine for the required contact time.

(6) *The suspended solids concentration.* Suspended solids can surround and protect organisms from the disinfectant.

6–5. Chlorine residuals

a. Normal conditions. Under normal operating conditions, water purification personnel will add sufficient chlorine to treated water to produce a chlorine residual of at least 5.0 ppm after 30 minutes contact time at a pH between 6.5 and 7.5. For Erdlator units, chlorine is added to the coagulator; for the ROWPU, chlorine is added after the reverse osmosis process because chlorine will damage the membranes.

b. Emergency conditions. If chlorine supplies are low and there is a need to conserve remaining supplies, the command surgeon may authorize reduced chlorine residuals. Recommended minimum chlorine residuals in emergency conditions based upon the pH of the water are presented in table 6-1. The residuals listed in table 6-1 apply when water temperatures are at or above 40 °F (5 °C); when water temperatures are below 40 °F, these residuals should be doubled.

Table 6-1. Recommended minimum chlorine residuals in emergency conditions based upon pH

pH	30-minute chlorine residuals (in ppm)
5	0.75
6	0.75
7	1.00
8	3.00
9	5.00
10	5.00

c. Chlorine-resistant organisms. Disease-producing organisms such as *Entamoeba histolytica* and *Giardia lamblia* are resistant to normal chlorine residuals. In areas where they are prevalent, the command surgeon may require higher than normal residuals, longer contact times, and filtration.

d. Residual measurement.

(1) The chlorine residual will be measured every hour of the operating day at water purification and distribution points.

(2) The chlorine residual will be measured two times a day or at frequent intervals to ensure adequate disinfection of company level and smaller unit water supplies contained in water trailers, fabric drums, and Lyster bags.

(3) Procedures for measuring chlorine residuals and pH are presented in appendix E and FM 21-10, appendix A, task 5.

Section III. Alternate Disinfectants

6–6. Iodine

Iodine is the active disinfectant used in individual water purification tablets. A bottle of 50 tablets (NSN 6850-00-985-7166) is issued to each soldier by the field sanitation team. Each tablet liberates 8 milligrams of iodine. Procedures for their use are presented in FM 21-10, chapter 2, section IV.

6–7. Boiling

Boiling is an expedient means of disinfecting small quantities of water when no other means are available. To be effective in killing most disease-producing organisms, the water must be held at a rolling boil for 5 to 10 minutes. Longer boiling times may be prescribed by the command surgeon in areas where certain heat resistant organisms are prevalent. When cooled, the boiled water must be kept in a covered, uncontaminated container since boiling does not impart any residual disinfectant.

Chapter 7

Distribution and Storage Operations

Section I. Distribution and Storage Equipment

7-1. Distribution equipment

The distribution of large quantities of potable water under field conditions may be accomplished by pipeline, hoseline, semitrailer mounted fabric tanks, and tank trucks. Smaller quantities will be picked up from storage and distribution points in tank trucks, water trailers, collapsible fabric drums, or 5-gallon water cans. In some situations small quantities of water may be delivered by aircraft using the Forward Area Water Point Supply System (FAWPSS).

7-2. Storage equipment

Maneuver and support units are equipped with a variety of water storage equipment including canteens, 5-gallon water cans, collapsible fabric durms, and 400-gallon water trailers. Large quantities of water are stored by water supply companies in collapsible tanks ranging in size up to 50,000 gallons.

7-3. Emergency water containers

a. General. An adequate number of potable water containers may not always be available to support a mission. Circumstances such as destruction in combat, unexpected interruption of supply, or isolation from friendly forces may force a unit commander to use containers which are not approved for use with potable water. Alternative containers to be considered for use, in order of priority, include nonpotable water containers, liquid food product containers, and fuel containers.

b. Approval for use. Approval to use alternative containers under emergency conditions will be requested by the unit commander from the operations commander if conditions permit. The command surgeon will recommend approval or disapproval of the request.

c. Types of alternative containers.

(1) *Nonpotable water containers.*

(*a*) Water containers normally used to haul nonpotable water for construction purposes may be used in support of rapid deployment forces, natural disaster assistance, or combat emergencies when potable water containers are unavailable.

(*b*) Military nonpotable water containers include the WD6S 6,000-gallon water distributor, the 1,000-gallon water distributor, and fire department water tankers.

(2) *Liquid food product containers.*

(*a*) Civilian containers normally used to transport liquid food products may be used in support of natural disaster assistance or combat emergencies when potable water containers are unavailable.

(*b*) Liquid food product containers include those used to transport milk, syrups, juices, vegetable oils, molasses, wines, etc.

(3) *Fuel containers.*

(*a*) *Fuel containers will only be used in support of extreme emergencies during combat* when potable and nonpotable water containers are not available.

(*b*) Military fuel containers include 5-gallon containers, 55-gallon drums, M49 1,200-gallon fuel tank trucks, 5,000-gallon semitrailers, and various collapsible tanks and drums.

(*c*) There are several medical concerns regarding the use of fuel containers for potable water storage and distribution. Residual fuel or oil may impart adverse taste and odor to the water and make it unpalatable. In many contingency plans, increased individual consumption of water is necessary. Unpalatable water may lead to reduced consumption and increased possibilities for heat injury. In addition, the hose, gasket, and rubber materials used in fuel containers and pump systems are not acceptable for contact with potable water because these materials may be composed of substances which could leach toxic compounds into the water.

Section II. Care and Maintenance

7-4. General

Operation, maintenance, and repair of distribution and storage equipment will be accomplished according to the applicable technical manuals listed in appendix A, section II, and using only materials approved for contact with potable water. *The equipment will not be used for pumping, transporting, or storing fuel products.* Further guidance on field water distribution and storage is provided in FM 10-52, chapter 7.

7-5. Equipment cleaning

a. Requirements. The owning unit will maintain the cleanliness of unit water trailers and other water purification, storage, and distribution equipment. Water trailers will be clean upon arrival at a water point. Water purification and distribution personnel will refuse to fill unclean containers. Unit commanders will ensure water trailers and other potable water containers are inspected for cleanliness, tightness of seals and seams, and overall ability to perform their intended purpose. The unit field sanitation team will coordinate the regular maintenance and cleaning of water containers to ensure that the quality of potable water is not altered.

b. Frequency.

(1) *New equipment.* New equipment (such as water tanks, trailers and other containers) will be cleaned and sanitized prior to initial use. Once new equipment has been designated for use with potable water, it will not be contaminated with any nonpotable water or fuel. Stencil the words POTABLE WATER ONLY on both sides of the equipment's exterior.

(2) *Routine cleaning.* On a quarterly basis, all equipment associated with the production, storage, and distribution of potable water will be inspected, cleaned, and sanitized. Routine equipment cleaning helps ensure continued availability of the equipment for unit support and reduces the potential for the spread of infectious disease. This equipment will be free from defects such as excessive rust, corrosion, or chipping to internal surfaces and inlet or outlet devices that could result in contamination of the distributed or stored potable water. Defective equipment will be repaired or replaced per local standing operating procedures (SOPs) and applicable technical manuals (see app A, sec II).

c. Field cleaning. Potable water containers, which become dirty inside while in the field, will be cleaned prior to arrival at a water point. This cleaning will be performed as needed. To prevent dirt, leaves, windblown dust, and other contaminants from entering water containers, the unit commander must ensure the containers remain properly sealed. Manhole covers, spigot box covers, and filling ports should be kept closed, and dust caps should be attached to dispensing valves when water is not being drawn from the container.

d. Procedures. A detailed description of procedures for routine and emergency cleaning of new and used equipment is presented in appendix C.

7-6. Equipment sanitizing

a. Requirement. After cleaning, the owning unit will sanitize water containers with a 100 ppm chlorine solution.

b. Procedures. Procedures for sanitizing equipment and containers are presented in appendix C.

7-7. Equipment decontamination

a. General. In the early 1980's, chemical agents allegedly were used by various forces in conflicts located in Afghanistan, Iran, Iraq, and Vietnam. The integrated battlefield is no longer a possibility, it is a reality. Consequently, water purification and supply personnel and the unit field sanitation team must be prepared to protect potable water supplies from contamination. Such contamination is not limited to only chemical agents, but may include biological agents and radioactivity from nuclear weapons. The staff chemical officer coordinates decontamination operations within the appropriate combat element. In addition most units have an NBC officer or noncommissioned officer who teaches elements of NBC defense and decontamination to members of the unit.

b. Protective measures. The following protective measures should be implemented if the use of chemical or biological agents or nuclear weapons is expected. A complete discussion of NBC defense is provided in FM 21-48.

(1) Secure covers on all open water tanks and Lyster bags.

(2) Close doors and other openings on water purification units.

(3) Close manholes covers, spigot box covers, and pumping compartment doors on water trailers and water tank trucks.

(4) Place protective tarpaulins over water purification units, distribution equipment, and water containers.

(5) Move small portable water containers, such as Lyster bags and water cans, under shelter or into enclosed vehicles.

c. Decontamination procedures. Procedures for field expedient decontamination of equipment and containers are presented in appendix C. These procedures should only be used when the unit is isolated from the NBC defense company or detachment which is responsible for organized decontamination of equipment and personnel.

Section III. Preventive Medicine Inspection Program

7-8. Garrison inspections

a. Inspection requirements. The division PVNTMED section or designated separate PVNTMED TOE unit will organize a semiannual potable water container inspection program to be conducted in garrison to ensure each one is prepared for deployment. The inspection criteria listed in paragraphs

7-12 and 7-13 will be used in the program. A member of the owning unit's field sanitation team will accompany the PVNTMED inspector to answer questions and record deficiencies or problems.

b. Report requirements.

(1) The PVNTMED inspector records findings on DA Form 5457-R (Potable Water Container Inspection). Local reproduction is authorized on 8-1/2- by 11-inch paper. (DA Form 5457-R is located at the end of this publication.)

(2) The original is retained by the PVNTMED section and a copy is left with the owning unit. The owning unit can use their copy to initiate a repair order to direct support maintenance. PVNTMED personnel will provide a monthly summary of inspection actions to the command surgeon.

c. Ratings. Water trailers or tank trucks that have an "unsatisfactory" rating will not be used until repairs have been completed, and the container has been reinspected by a PVNTMED inspector and rated "satisfactory."

d. Program coordination.

(1) *Divisional units.* The division PVNTMED section will organize and conduct the inspection program for their division.

(2) *Nondivisional units.* The IMA will coordinate inspections for all non-TOE equipment. Such inspections could be performed by the U.S. Army Medical Department activity (MEDDAC) PVNTMED service or a separate PVNTMED detachment.

(3) *U.S. Army Reserve and National Guard Units.*

(a) With prior coordination and agreement, U.S. Army Reserve and National Guard units located at or near active Army installations may elect to participate in the garrison inspection program. Deficiencies will be corrected by the direct support maintenance activity of that unit in coordination with the appropriate medical authority.

(b) US Army Reserve and National Guard units which do not participate in an active Army installation inspection program will have their water trailers and tank trucks inspected during their annual active duty for training. The containers will be inspected by the local training post PVNTMED detachment using DA Form 5457-R. The report original will be retained in the post PVNTMED file. One copy will be sent to the owning unit for action. The surgeon should ensure that deficiencies identified in the report are corrected by the owning unit.

(1) For Reserve units, a summary of all inspection actions will be sent to the surgeon of the appropriate Army Reserve command to which the unit is assigned.

(2) For National Guard units, a summary of all inspection actions will be sent to the surgeon of the appropriate State's Adjutant General's office.

7-9. Field inspections

a. Inspection requirement. The PVNTMED section or detachment will perform periodic inspections of water storage and distribution equipment to maintain an acceptable level of sanitation. A field sanitation team member or distribution team chief will accompany the inspector to answer questions and note any deficiencies or problems.

b. Report requirements. Inspection findings will be recorded on DA Form 5457-R. The original report is retained by the PVNTMED section or detachment. One copy is sent to the command surgeon and one copy is left with the owning unit. The owning unit can use their copy to initiate a repair order to direct support maintenance.

Section IV. Preventive Medicine Inspection Criteria

7-10. General

The inspection criteria listed in paragraphs 7-11 through 7-15 are applicable to the interior and various exterior apparatus of potable water supply containers. The condition of these items can directly affect the quality of the potable water stored or transported within them. The using unit is responsible for prompt corrections of any deficiencies noted in the PVNTMED inspection.

7-11. Container appearance

a. The interior and exterior of the container will be clean and in a good state of repair.

b. The exterior of the container will be stenciled with the words POTABLE WATER ONLY.

7-12. Four-hundred-gallon water trailers

a. Manhole covers.

(1) Manhole covers will seal effectively to prevent contamination of contents. Rubber gaskets will be intact and will not have cracks, missing pieces, excessive dry rot, or an improper fit.

(2) The manhole cover locking mechanism will function.

(3) The manhole cover and interior will not be rusted.

(4) The manhole cover insulation should not be damaged.

(5) The pressure relief valve will operate effectively. The pressure relief valve may be tested by blowing into the bottom. The valve is operating effectively if air escapes through the holes in the top of the valve.

(6) Manhole cover defects should be repaired by organizational maintenance per—

(*a*) TM 9-2330-213-14&P/TO 36A11-1-461, paragraph 3-42a, for M107 series water trailers.

(*b*) TM 9-2330-267-14&P, paragraphs 4-33 and 4-34, for M149 series and M625 water trailers.

b. Dispensing spigots.

(1) All spigots will function.

(2) The "T" handle that dispenses water from the tank to the spigots will open and close freely.

(3) The protective box will be intact.

(4) Locking devices for spigot covers will function properly.

(5) Piping system and spigot defects should be repaired by organizational maintenance per—

(*a*) TM 9-2330-213-14&P/TO 36A11-1-461, paragraphs 3-42b through f, for M107 series water trailers.

(*b*) TM 9-2330-267-14&P, paragraph 4-36, for M149 series and M625 water trailers.

c. Drain.

(1) The drain plug will be easily removable.

(2) Threads in the plug and drain hole will not be stripped or damaged.

(3) Interior surface cracks around the drain hole are a result of excessive pressure applied to remove or install the plug. Subsurface cracks that expose the fiberglass body should be repaired by direct support maintenance per TM 9-2330-267-14&P, paragraph 5-10.

(4) The plug will be installed hand tight only.

(5) Thread corrosion will be removed at least semiannually.

d. Interior surfaces.

(1) Stainless steel and aluminum tanks.

(*a*) Interior seams will be free of rust; rusted seams will be scrubbed with a *nonmetalic brush* using a nonabrasive, nonchlorinated cleanser and will be thoroughly rinsed.

(*b*) Interiors will not be painted or coated with any material.

(*c*) Cracks and dents that expose the polyurethane foam insulation are not permitted and the tank should be repaired.

(*d*) Water tank interiors should be repaired by direct support maintenance per TM 9-2330-213-14&P/TO 36A11-1-461, paragraph 4-16, for M107 aluminum water tanks, and per TM 9-2330-267-14&P, paragraph 5-9, for M149 stainless steel water tanks.

(2) *Fiberglass tanks.*

(*a*) *Stains.* Stains on the interior surface resulting from natural water impurities (such as iron or manganese) are permitted as long as they do not interfere with disinfection. Stains resulting from rusting apparatus, the storage of unauthorized liquids, or improper painting should not be permitted. Such stains will be cleaned and disinfected per TM 9-2330-267-14&P, paragraph 3-7*a*.

(*b*) *Chips.* Chips of the interior surface provide ideal areas for biological growth and entrapment of dirt or waterborne solids. Surface chips that do not expose the fiberglass body of the tank may be permitted if they cover less than 10 percent of the interior. Chips in excess of 10 percent or any chips which expose the fiberglass subsurface are not permitted and the tank should be repaired by direct support maintenance per TM 9-2330-267-14&P, paragraph 5-10.

(*c*) *Cracks.* Cracks are the most commonly observed interior surface defect. They can harbor microbiological organisms which constitute a health hazard. Surface cracks covering greater than 10 percent of the interior should be removed and the surface refinished. Minor surface cracks covering less than 10 percent of the interior should be noted by the inspector but are permitted. Subsurface cracks that expose the fiberglass body are not permitted and the tank should be repaired by direct support maintenance per TM 9-2330-267-14&P, paragraph 5-10.

(*d*) *Flaking.* Flaking of interior surface paint may result from the use of an unauthorized paint or improper subsurface preparation. The cause of such flaking should be determined and remedial action should be taken.

7-13. Tank trucks

a. Manhole covers. Inspection criteria are the same as those for 400-gallon water trailers except that paragraphs 7-12*a*(5) and (6) are omitted.

b. Dispensing valves.

(1) Valves should operate freely and close tightly.

(2) Threads for hose couplings should be intact and undamaged.

(3) Dust caps should be attached to dispensing valve ports whenever the valve is not in use.

c. Filling ports.

(1) Rubber gaskets will be intact, fit properly, and be free of dry rot.

(2) Mesh screens inside the port should be free of rust.

d. Interior surfaces. Metal interiors will not be painted and should be free of rust.

e. Repair of tank truck defects.

(1) 1000-gallon water tank truck (M50 series).

(*a*) Organizational maintenance, troubleshooting, and repair procedures for water tank body components, such as manhole covers, dispensing equipment, and filling ports, are presented in TM 9-2320-209-20-2-2, chapters 61 through 64, and in TM 9-2320-209-20-3-3, chapter 18, section VII. A list of organizational maintenance repair parts for tank body components is presented in TM 9-2320-209-20P, fig-

ures 175D through 199.

(*b*) Direct support and general support maintenance and repair procedures for water tank body components are presented in TM 9-2320-209-34-2-2, chapter 17, section VI. A list of direct support and general support maintenance repair parts for tank body components is presented in TM 9-2320-209-34P, figures 156 through 181.

(*2*) 5000-gallon bulk haul tank semitrailer.

(*a*) Organizational maintenance and repair procedures for tank body components and dispensing equipment are presented in TM 9-2330-356-12&P, sections XVI and XX, respectively. A list of organizational maintenance repair parts for tank body components and dispensing equipment is presented in TM 9-2330-356-12&P, appendix E, figures 35 through 48 and 112 through 140, respectively.

(*b*) Direct support and general support maintenance and repair procedures for dispensing equipment are presented in TM 9-2330-356-34&P, chapter 5. A list of direct support and general support repair parts for dispensing equipment is presented in TM 9-2330-356-34&P, appendix B, figures 106 through 140.

7-14. Fabric water tanks and drums

a. Exterior. If the container has been repaired, any patch or temporary plug will be secure.

b. Valve assembly.

(1) The check-valve adapter will be undamaged.

(2) The check valve will open easily.

(3) The dust cap will be attached to the coupler whenever the coupler is not in use.

c. Repair of defects. Defects in 250- and 55-gallon collapsible fabric water drums should be repaired by the appropriate level of maintenance per TM 10-8110-201-14&P. Appropriate repair parts and kits are listed in appendix C of the TM.

7-15. Water trailer locations and dry distribution points

a. Site conditions.

(1) Manholes and ports will be closed.

(2) Soakage pits will be constructed.

b. Water conditions.

(1) Water will be tested for chlorine residual.

(*a*) At dry distribution points operated by quartermaster units, potable water chlorine residuals will be at least 5 ppm or at a higher level if prescribed by the command surgeon.

(*b*) When unit water supplies have been procured from a potable distribution point, the potable water chlorine residual at the point of consumption (such as unit water trailers, collapsible fabric drums, or Lyster bags) will be at least 1 ppm or at a higher level if prescribed by the command surgeon.

(*c*) When the unit must disinfect a raw water supply (such as a stream, pond, lake, or other fresh water body), the potable water chlorine residual after disinfection at the point of consumption will be at least 5 ppm or at a higher level if prescribed by the command surgeon.

(2) Indicate from where the water was procured.

Chapter 8

Clothing Exchange, Bath, and Personnel Decontamination Operations

Section I. Field Shower and Decontamination Equipment

8-1. Field showers

Field shower equipment consists of pumps, heater unit, generator, portable eight-head shower unit, tentage, and vehicles. Water storage tanks are used for storing potable water or for treating and storing nonpotable fresh water available on site. Clothing exchange and bath operations are discussed in FM 10-280. Operation and maintenance of bath units are discussed in AR 700-135 and TM 10-4510-201-14. Water planning factors for showers are included in FM 10-52, appendix C.

8-2. Personnel decontamination station

Field shower equipment can be modified for use as a personnel decontamination station which is operated by Chemical Corps detachments. Water used for personnel decontamination will be decontaminated, disinfected, and at least a 5 ppm chlorine residual maintained in the decontaminated water during its use. Personnel decontamination station operations are discussed in FM 3-87 and TM 3-220. Operation and maintenance of decontaminating apparatus are discussed in TM 3-4230-209-12. Water planning factors for decontamination are included in FM 10-52, appendix C.

Section II. Water Source Surveillance and Waste Disposal Procedures

8-3. General

Water for showers need not meet all of the drinking water standards, but should not impair the health of personnel (AR 700-136, para 4*b*). Surveillance and selection of field shower sites should be performed using methods similar to those used for water points. In certain areas, a sanitary survey by PVNTMED personnel may be necessary to determine existing levels of contamination by microorganisms, including schistosomes. If the sanitary survey indicates contamination which could be a health hazard to personnel, the command surgeon can direct the shower water be disinfected by procedures which maintain a chlorine residual of 1 ppm or greater. If disinfection is required, the logistics staff officer should be contacted to arrange for augmentation of equipment for bath units. Such equipment could include diatomaceous earth or cartridge filters for schistosome removal, water storage tanks, and calcium hypochlorite or bleach.

8-4. Waste disposal procedures

a. Environmental considerations. In some areas because of Federal, State, and local environmental laws, wastewater cannot be discharged to adjacent streams, lakes, or other receiving bodies. As stated in AR 700-135, paragraph 5, commanders with bath units participating in field training exercises in the United States and its possessions will coordinate with the installation facility engineer's environmental officer to determine how to dispose of wastewater. The environmental officer can assist the commander in securing a discharge permit if required. Outside of the continental United States, commanders will coordinate wastewater disposal with the environmental agency in the host country.

b. Procedures.

(*1*) *Regulated discharges.* In cases where a discharge permit has been secured, the bath unit or personnel decontamination station section chief will comply with the permit to prevent contamination of the receiving body. In cases where a permit has been denied, the section chief should contact the environmental officer of the installation to determine if wastewater could be discharged into a sanitary sewer manhole. Such action should also involve coordination with the chief of the wastewater treatment plant.

(*2*) *Unregulated discharges.* Even when a discharge permit is not required, section chiefs should still take precautions to avoid contaminating a receiving body of water which may be needed somewhere downstream or along the shore for a water source for another activity. Wastewater should be channeled from the shower area in a drainage ditch to prevent formation of puddles which could serve as insect breeding areas. Drainage ditches should discharge wastewater at least 25 yards (23 m) downstream of the raw water intake or, for personnel decontamination stations, into soakage pits or sumps away from the water source per TM 3-220, paragraph 20d(3). When the unit vacates the area, any such soakage pits

or sumps will be closed out and properly marked.

c. Technical assistance. Requests for technical assistance in disposing of wastewater should be referred to the appropriate Army agency or laboratory listed in appendix B.

Section III. Preventive Medicine Inspection Program

8-5. Garrison inspections

No PVNTMED inspections of field shower or personnel decontamination equipment will be required in garrison.

8-6. Field inspections

a. Inspection requirement. The PVNTMED section or detachment will perform periodic inspections of field shower points and personnel decontamination stations to ensure sanitary conditions are maintained. Criteria for the inspection are given in section IV. The shower decontamination point section team chief will accompany the inspector to answer questions and note deficiencies or problems.

b. Report requirements.

(1) Inspection findings will be recorded on DA Form 5458-R (Shower/Decontamination Point Inspection). Local reproduction is authorized on 8½- by 11-inch paper. (DA Form 5458-R is located at the end of this publication.)

(2) The original report is retained by the PVNTMED section or detachment. A copy will be left with the inspected unit at the time of the survey and a copy will be forwarded to the headquarters of the unit to which the clothing exchange and bath platoon or decontamination section is attached.

Section IV. Preventive Medicine Inspection Criteria

8-7. General

The inspection criteria listed in paragraphs 8-8 through 8-12 are applicable to both field showers and personnel decontamination stations. The criteria must be enforced to safeguard the health of the troops. The owning unit is responsible for prompt corrections of any deficiencies noted in the PVNTMED inspection.

8-8. Site conditions

a. Development.

(1) The bath site will be located on firm, well-drained ground.

(2) Rodent and insect breeding areas should be controlled to prevent the spread of disease.

(3) Separate latrines should be provided for each sex. The numbers should be based on the population to be served and the duration of services.

(4) Handwashing devices will be provided and supplied with soap and water.

(5) Garbage and trash will be properly stored and disposed of.

b. Water source.

(1) Nonpotable water will be chlorinated to at least a 1 ppm chlorine residual or greater if prescribed by the command surgeon.

(2) Tests for chemical agents and radioactivity (table 4-1) will be conducted weekly by water purification personnel. The frequency of tests is related to the MOPP conditions as shown in table 5-1.

(3) Record from where the water source was procured or supplied.

c. Wastewater control.

(1) Drainage ditches will convey shower wastewater away from the area.

(2) Wastewater and runoff will be discharged at least 25 yards (23 m) downstream of the raw water intake.

(3) For decontamination stations, contaminated wastewater will be drained to soakage pits or sumps away from the water source.

(4) Soakage pits and decontamination waste sumps will be closed out and marked properly when the unit vacates the area.

8-9. Equipment

a. Intake line. These criteria are the same as those specified in paragraph 5-10*a*.

b. Shower unit.

(1) Shower surfaces, nozzles, and floors will be kept clean of dirt, algae, and soap.

(2) Air circulation will be provided to reduce humidity and odors.

(3) If the shower water is not potable, a sign will be posted at the shower entrance stating: NONPOTABLE WATER. DO NOT DRINK.

c. Generator.

(1) The generator should be located at least 50 feet (15 m) from the shower area and will be sandbagged.

(2) Other criteria are the same as those specified in paragraph 5-10*e*.

8-10. Monitoring and storage of water

a. Water monitoring (operator).

(1) Chlorine residuals will be checked every 8 hours by personnel of the operating unit. The chlorine residual will be at least 1 ppm or higher as directed by the command surgeon.

(2) Treated water will be tested using the Water Testing Kit, Chemical Agents (M272). Testing will be performed by operating unit personnel at the frequency specified in table 5-1. The kit must contain sufficient reagents for 24 hours of continuous analysis under MOPP 4 conditions.

(3) Shower water temperatures should be monitored by operating personnel and should be maintained between 95 °F and 105 °F (35-41 °C).

b. Water storage. These criteria will be the same as those specified in paragraph 5-11*b*.

8-11. Recordkeeping and supply storage

a. Records.

(1) A bath and clothing exchange report may be used to report daily, weekly and monthly activities. A suggested report is discussed in FM 10-280.

(2) Blank forms on hand should be sufficient for the anticipated duration of operations or until resupply can be effected.

b. Supply storage.

(1) Fuel and chemicals on hand should be sufficient for the anticipated duration of operations or until resupply can be effected.

(2) Chemical containers will be labeled properly, capped tightly, and kept dry.

(3) Activated carbon and calcium hypochlorite will be stored separately to prevent mixing that could result in a violent reaction.

8-12. Shower water samples

a. The PVNTMED inspector will collect shower water samples from shower heads at each shower point. These samples will be analyzed for the following constituents:

(1) Chlorine residual.

(2) Chemical agents.

(3) Radioactivity.

(4) Water temperature.

b. Concentrations of chemical agents and radioactivity will not exceed the standards for those constituents listed in table 3-2. The chlorine residual and water temperature should conform to the levels specified in paragraph 8-10*a*.

Chapter 9

Water Conservation, Recycle, and Reuse

9-1. General

The concepts of water conservation, recycle, and reuse have not been widely practiced in the field. However, in certain areas where water supplies are few and demand is high, recycle and reuse of water may be necessary to effectively use those quantities of water that are available. For certain activities, water recycle or reuse may necessitate PVNTMED inspections to safeguard the user.

9-2. Considerations for conservation, recycle, and reuse

a. Conservation. Water will not be recycled or reused for drinking, personal hygiene, food preparation, medical treatment, or any other use where potable water is required. In addition, no water will be recycled or reused when chemical or biological agents or nuclear weapons have been used. As a result of these restrictions, the only way to provide adequate amounts of potable water in water-short areas is to conserve supplies. Conservation includes minimizing spillage when transferring water from one container to another, covering open tanks to reduce evaporation and contamination by dust, and reducing wastage. Equipment modifications which can help conserve water supplies include spring-loaded faucets in sinks, spring-loaded or pull-chain shower head valves, and water-conserving shower heads. For portable bath units which do not have individual valves on shower heads, the section chief can time the shower to reduce water usage.

b. Recycle. Recyling water involves using it again for the same purpose, usually by treating the wastewater and returning it to the beginning of the operation. Certain types of wastewater, mainly from shower and laundry operations, can be treated on site and recycled for the same purpose. Shower and laundry wastewater can be collected, batch treated, disinfected, and pumped back to the unit. Such recycling operations are more easily used in a cantonment area than in mobile field operations.

c. Reuse. Reusing water involves using it again for a different purpose than it was originally, such as in laundry operations having rinsewater reused as wash water in the wash cycle. In mess operations, meltwater from iceboxes could be used for rinse water in messkit laundries and the rinse water reused as wash water in the next messkit laundry. Under certain conditions, shower and laundry wastewater could be collected and stored, then transported in engineer nonpotable water distributor tank trucks for use in construction.

9-3. Treatment

Batch treatment for recycling can be accomplished with stave tanks and onsite treatment processes. Advice of water treatment experts in environmental engineering medical detachments (LC Teams) should be obtained to plan and implement treatment systems. A physical/chemical treatment system might include coagulation, sedimentation, filtration, and the addition of powdered activated carbon. Disinfection will be required in all cases of recycling involving human contact with the water.

9-4. Recycled water standards

a. Purpose. The purpose of these standards is to protect the health of the troops, including prevention of skin and eye irritation from recycled shower water.

b. Standards. These standards represent the maximum acceptable limit of each constituent.

(1) pH: 6.5 to 7.5 units.
(2) Turbidity: 5 NTU.
(3) Hardness: 500 mg/L.

c. Chlorine residuals. The recycled water will be disinfected with chlorine using a minimum contact time of 30 minutes. The chlorine residual will be maintained at 5 ppm for water temperatures at or above 68 °F (20 °C) and at 10 ppm for water temperatures below 68 °F (20 °C).

9-5. Operational control monitoring

Personnel operating recycling equipment will perform monitoring to control the process involved. Assistance in determining the operational control monitoring required can be obtained from LC teams. Water recycled for operations involving personal contact will be tested hourly for chlorine residual.

9-6. Preventive medicine inspection program

a. Purpose. Sanitary inspections of recycling operations safeguard the health of the troops by ensuring the treatment and handling of recycled wastewater is conducted properly.

b. Inspection requirement. Water recycling equipment will not be evaluated in the garrison situations unless it cannot be evaluated in the field training envi-

ronment. In the field or combat environment, PVNTMED inspections of recycling equipment will be performed periodically.

c. Inspection criteria.

(1) Field shower points with recycling equipment will be inspected using the same criteria as those found in paragraphs 8-8 through 8-11.

(2) Shower water samples will be collected from shower heads and analyzed for the following constituents:

(*a*) Chlorine residual.
(*b*) Chemical agents.
(*c*) Hardness.
(*d*) pH.
(*e*) Radioactivity.
(*f*) Turbidity.
(*g*) Water temperature.

(3) Shower water samples, when analyzed, will comply with the following requirements:

(*a*) Concentrations of chemical agents and radioactivity will not exceed the standards for those constituents listed in table 3-2.

(*b*) The chlorine residual, hardness, pH, and turbidity should conform to the levels specified in paragraph 9-4*b* and *c*.

(*c*) The water temperature should fall between 95 and 105 °F (35 and 41 °C).

(4) Provide a brief description of the recycling treatment process.

d. Report requirements. Inspection findings will be recorded on DA Form 5458-R and distributed as specified in paragraph 8-6*b*.

Appendix A

References

Section I. Required Publications

AR 40-5
Preventive Medicine. (Cited in paras 1-1*c*; and 1-4*h*(5), (7), and *i*(5).)

AR 700-136
Land Based Water Resources Management in Contingency Operations. (Cited in paras 1-4*e* and *h*, and 8-3.)

DHEW (NIOSH) Publication 80-106
Criteria for a Recommended Standard, Working in Confined Spaces. (Cited in paras C-2*a*(1) and C-3*c*.) (Copies of this publication may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

FM 10-52
Field Water Supply. (Cited in paras 1-4*e*(3) and *f*(8), 2-3, 4-6, 4-8*c*, 5-1*b*, 5-4, 5-5*b*(1), 5-12*a*, 7-4, 8-1, 8-2, and C-5*b*(2)(*d*).

FM 10-280
Field Laundry, Clothing Exchange and Bath Operations. (Cited in paras 8-1 and 8-11*a*.)

FM 21-10/AFM 161-10
Field Hygiene and Sanitation. (Cited in paras 1-4*g*(11), *h*(3), (6), (8), and *i*(2), (3), (8), (9); 2-1; 2-6; 3-2*b*(1); 5-9*b*(2); 6-3*a*; 6-7*d*(3); 6-6; and E-2.)

TB 43-0153
Water Supply Afloat. (Cited in para 1-1.)

TC 8-3
Field Sanitation Team Training. (Cited in para 1-4*g*(11) and *h*(6).)

TM 3-220
Chemical, Biological, and Radiological (CBR) Decontamination. (Cited in paras 1-4*d*(9), *f*(9), *i*(6), and *j*(4); 8-2; 8-4*b*(2); and C-5*a*(2).)

TM 3-6665-319-10
Operator's Manual for Water Testing Kit, Chemical Agents: M272 (NSN 6665-01-134-0885). (Cited in para 3-2*b*(2)(*b*) and table 4-1.)

TM 5-6630-215-12
Operator and Organizational Maintenance Manual for Quality Analysis/Sets: Preventive Medicine (NSN 6630-00-140-7826), Engineer (6630-00-140-7820). (Cited in para E-3 and table 4-1.)

TM 9-2330-213-14&P/TO 36A11-1-461
Operator's, Organizational, Direct Support and General Support Maintenance Manual Including Repair Parts and Special Tools List for Chassis, Trailer 1 1/2-Ton, 2-Wheel, M103A1 (NSN 2330-00-835-8629), M103A2 (2330-00-049-8050), M103A3 (2330-00-141-8052), M103A3C (2330-00-542-2181), M103A4 (2330-00-141-8051), and Trailer, Cargo, 1 1/2-Ton, 2-Wheel: M105A1 (2330-00-835-8631), M105A2 (2330-00-141-8050), M105A2C (2330-00-542-5689); Trailer, Tank, Water, 1 1/2-Ton, 2-Wheel, 400 Gallon, M107A1 (2330-00-835-8633), M107A2 (2330-00-141-8049), M107A2C (2330-00-542-5688), and Trailer, Van, Shop, Folding Sides, 1 1/2-Ton, 2-Wheel, M448 (2330-00-631-5692). (Cited in para 7-12*a*(6)(*a*), *b*(5)(*a*), and *d*(1)(*d*).)

TM 9-2330-267-14&P
Operator's, Organizational, Direct Support, and General Support Maintenance Manual Including Repair Parts and Special Tools List for Trailer, Tank, Potable Water, 400 Gallons, 1 1/2-Ton, 2-Wheel, M149 (NSN 2330-00-542-2039), M149A2 (2330-01-108-7367) and M265 (2330-00-782-6059). Cited in para 7-12*a*(6)(*b*), *b*(5)(*b*), *c*(3), and *d*.

TM 11-6665-209-10
Operator's Manual for Radiac Sets: AN/PDR-27J (NSN 6665-00-343-1435), AN/PDR-27L (6665-00-756-3456), and AN/PDR-27O (6665-00-017-8903). (Cited in table 4-1.)

TM 11-6625-230-12	Operator's and Organizational Maintenance Manual for Radiac Set, AN/PDR-27R (NSN 6665-00-961-0846). (Cited in table 4-1.)

Section II. Related Publications*

AR 115-21	Military Hydrology
AR 200-1	Environmental Protection and Enhancement
AR 310-25	Dictionary of United States Army Terms (Short Title: AD)
AR 700-135	Mobile Field Laundry and Bath Operations
FM 3-87 (HTF)	Nuclear, Biological, and Chemical (NBC) Reconnaissance and Decontamination Operations (How to Fight)
FM 8-15	Medical Support in Divisions, Separate Brigades, and the Armored Cavalry Regiment
FM 8-33	Control of Communicable Diseases in Man, 14th Edition
FM 10-52-1	Commander's Handbook for Water Usage in Desert Operations
FM 21-48	Planning and Conducting Chemical, Biological, Radiological (CBR), and Nuclear Defense Training
FM 31-70	Basic Cold Weather Manual
FM 31-71	Northern Operations
FM 90-3 (HTF)	Desert Operations (How to Fight)
FM 90-6 (HTF)	Mountain Operations (How to Fight)
STP 8-91S15-SM-TG	Soldier's Manual and Trainer's Guide: 91S, Environmental Health Specialist (Skill Level 1/2/3/4/5)
STP 10-51N1-SM	Soldier's Manual: 51N, Water Treatment Specialist (Skill Level 1)
STP 10-51N24-SM-TG	Soldier's Manual and Trainer's Guide: 51N, Water Treatment Specialist (Skill Level 2/3/4)
TB MED 81/NAVMED P-5052-29/AFP 161-11	Cold Injury
TB MED 288	Medical Problems of Man at High Terrestrial Elevations
TB MED 507/NAVMED 1052.5/AFP 161-7	Occupational and Environmental Health: Prevention, Treatment and Control of Heat Injury
TB MED 530	Occupational and Environmental Health: Food Service Sanitation
TM 3-4230-209-12	Operator's and Organizational Maintenance Manual: Decontaminating Apparatus, Power-driven, Skid-mounted, Multipurpose, Nonintegral, 500 Gallon, ABC M12A1 (FSN 4230-926-9488)
TM 5-660	Operation of Water Supply and Treatment Facilities at Fixed Army Installations
TM 5-4610-207-12	Operator's and Organizational Maintenance Manual: Water Pretreatment Decontamination Set (C and B Agents, Trailer Mtd) (NSN 4610-00-782-2807)
TM 5-4610-208-14	Operator's, Organizational, Direct Support, and General Support Maintenance Manual: Water Purification Unit, 420 Gallons Per hour, Electric Driven; 115 V, Single Phase, 60 Hz, 1/20 to 1/4 HP (Litton Systems, Inc., Model LPU-420-1) (NSN 4610-00-012-5490) and (Met-Pro Systems, Inc. Model 420-1974) (4610-00-165-4964)
TM 5-4610-215-10	Operator's Manual for Water Purification Unit, Reverse Osmosis, 600 GPH, Trailer Mtd, Flatbed Cargo, 5-Ton, 4-Wheel Tandem, Model ROWPU 600-1 (NSN 4610-01-093-2380)
TM 5-4610-218-12	Operator's and Organizational Manual: Water Purification Unit, Van Type, Body Mounted, Electric Motor Driven, AC, DC, 115/208 V, Single and 3 Phase, 60 Hz, 1/20 to 2 HP, 1500 GPH, Model EMC-1500S (NSN 4610-01-037-8746)
TM 5-4610-221-12	Operator's and Organizational Maintenance Manual: Water Purification Unit: Van-Type Body Mounted, Electric Driven, AC,

*A related publication is merely a source of additional information. The user does not have to read it to understand this bulletin.

	115/208V, Single- and 3-Phase, 60 Hz, 1/2 to 2-HP, 1500 GPH (Met-Pro Model 1500-2600A (NSN 4610-00-879-4612)) (ETC Model S1500 (4610-00-016-9964))
TM 5-4610-223-12	Operator's and Organizational Maintenance Manual for Water Purification Unit, Van-Type, Body Mounted, Electric Driven, AC, 115/208 V, Single and 3 Phase, 60 Hz, 1/20 to 2 HP, 3000 GPH (MET-PRO Model 3000 V) (NSN 4610-00-168-1799)
TM 8-250	Environmental Health Technician
TM 8-285/NAVMED P-5041/AFM 160-12	Treatment of Chemical Agent Casualties and Conventional Military Injuries
TM 9-2320-209-10-1/TO 36A12-1B-1091-3	Operation, Installation and Reference Data Operator Level for 2 1/2-Ton, 6X6, M44A1 and M44A2 Series Trucks (Multifuel), Cargo, M35A1 W/O Winch (NSN 2320-00-542-5633) W/W (2320-00-542-5634), M35A2 W/O Winch (2320-00-077-1616) W/W (2320-00-077-1617), M35A2C W/O Winch (2320-00-926-0873) W/W (2320-00-926-0875), M36A2 W/O Winch (2320-00-077-1618) W/W (2320-00-077-1619), Tank, Fuel, M49A1C, W/O Winch (2320-00-440-3349) W/W (2320-00-440-3346), M49A2C W/O Winch (2320-00-077-1631) W/W (2320-00-077-1632), Tank, Water, M50A1 W/O Winch (2320-00-440-8307), W/W (2320-00-440-8305), M50A2 W/O Winch (2320-00-077-1633) W/W (2320-00-077-1634) M50A3 W/O Winch (2320-00-937-4036) W/W (2320-00-937-5264); Van, Shop M109A2 W/O Winch (2320-00-440-8313), W/W (2320-00-440-8308), M109A3 W/O Winch (2320-00-077-1636), W/W (2320-00-077-1637), Repair Shop M185A2, W/O Winch (4940-00-987-8799), W/W (4940-00-987-8800), M185A3 W/O Winch (4940-00-077-1638), W/W (4940-00-077-1639); Tractor M275A1 W/O Winch (2320-00-446-2479), M257A2, W/O Winch (2320-00-077-1640), W/W (2320-00-077-1641); Dump M342A2, W/O Winch (2320-00-077-1643), W/W (2320-00-077-1644); Maintenance, Pipeline Construction M756A2 W/W (2320-00-904-3277); and Maintenance, Earth Boring and Polesetting M764 W/W (2320-00-937-5980)
TM 9-2320-209-20-1/TO 36A12-1B-1092-1-1	Scheduled Maintenance Organizational Level 2 1/2-Ton, 6X6, M44A1 and M44A2 Series Trucks (Multifuel); Cargo: M35A1, M35A2, M35A2C, M36A2; Tank, Fuel: M49A1C, M49A2C; Tank, Water: M50A1, M50A2, M50A3; Van, Shop: M109A2, M109A3; Repair Shop: M185A2, M185A3; Tractor: M275A1, M275A2; Dump: M342A2; Maintenance, Pipeline Construction: M756A2 and Maintenance, Earth Boring and Polesetting: M764
TM 9-2320-209-20- 2-2/TO 36A12-1B-1092-1-2-2	Organizational Level for 2 1/2-Ton, 6X6, M44A1 and M44A2 Series Trucks (Multifuel); Cargo: M35A1, M35A2, M35A2C, M36A2; Tank, Fuel: M49A1C, M49A2C; Tank, Water: M50A1, M50A2, M50A3; Van, Shop: M109A2, M109A3; Repair Shop: M185A2, M185A3; Tractor: M275A1, M275A2; Dump: M342A2; Maintenance, Pipeline Construction: M756A2; and Maintenance, Earth Boring and Polesetting: M764
TM 9-2320-209-20-3-3/TO 36A12-1B-1092-1-3	Organizational Level for 2 1/2-Ton, 6X6, M44A1 and M44A2 Series Trucks (Multifuel); Cargo: M35A1, M35A2, M35A2C, M36A2; Tank, Fuel: M49A1C, M49A2C; Tank, Water: M50A1, M50A2, M50A3; Van, Shop: M109A2, M109A3; Repair Shop: M185A2, M185A3; Tractor: M275A1, M275A2; Dump: M342A2; Maintenance, Pipeline Construction: M756A2; and Maintenance, Earth Boring and Polesetting: M764

TM 9-2320-209-20P/TO 362-1-494	Organizational Maintenance Repair Parts and Special Tools List for 2 1/2-Ton, 6X6 Truck; Instrument Repair Shop, Truck Mounted: M185, M185A1, M185A2, M185A3; Cargo: M34, M35, M35A1, M35A2, M35A2C, M36, M36A2, M36C; Dump: M47, M59, M342A2; Maintenance, Earth Boring Machine and Pole Setter: V18A/MTQ, M764; Maintenance, Telephone Construction and Maintenance: V17A/MTZ; Pipeline Construction: M756, M756A2; Tank, Fuel Servicing, 1,200 Gal: M49, M49A1C, M49A2C, M49C; Tank, Water, 1,000 Gal: M50, M50A1, M50A2, M50A3; Tractor: M48, M275, M275A1, M275A2; Van, Expansible: M292, M292A1, M292A2, M292A5; Van, Shop: M109, M109A1, M109A2, M109A3; Wrecker, Crane: M108; and Wrecker, Light: M60
TM 9-2320-209-34-2-2/TO 36A12-1B-1092-2-2	Direct Support and General Support Level 2 1/2 Ton, 6X6, M44A1 and M44A2 Series Trucks (Multifuel); Cargo: M35A1 W/O Winch (NSN 2320-00-542-5633), W/Winch (2320-00-542-5634), M35A2 W/O Winch (2320-00-077-1616), W/Winch (2320-00-077-1617), M35A2C W/O Winch (2320-00-926-0873), W/Winch (2320-00-926-0875), M36A2 W/O Winch (2320-00-077-1618), W/Winch (2320-00-077-1619); Tank, Fuel: M49A1C W/O Winch (2320-00-440-3349), W/W (2320-00-440-3346), M49A2C W/O Winch (2320-00-077-1631), W/W (2320-00-077-1632); Tank, Water: M50A1 W/O Winch (2320-00-440-8307), W/W (2320-00-440-8305), M50A2 W/O Winch (2320-00-077-1633), W/W (2320-00-077-1634), M50A3 W/O Winch (2320-00-937-4036), W/W (2320-00-937-5264); Van, Shop: M109A2 W/O Winch (2320-00-440-8313), W/W (2320-00-440-8308), M109A3 W/O Winch (2320-00-077-1636), W/W (2320-00-077-1637); Repair Shop: W/O Winch (2320-00-987-8799), W/W (2320-00-987-8800), M185A3 W/O Winch (4940-00-077-1638), W/W (4940-00-077-1639); Tractor: M275A1 W/O Winch (2320-00-446-2479), M275A2 W/O Winch (2320-00-077-1640), W/W (2320-00-077-1641); Dump: M342A2 W/O Winch (2320-00-077-1643), W/W (2320-00-077-1644); Maintenance, Pipeline Construction: M756A2 W/W (2320-00-904-3277); and Maintenance, Earth Boring and Polesetting: M764 (2320-00-937-5980)
TM 9-2320-209-34P/TO 36A12-1-494	Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for 2 1/2-Ton, 6X6 Truck, Instrument Repair Shop, Truck MTD: M185, M185A1, M185A2, M185A3; Cargo: M34, M35, M35A1, M35A2, M35A2C, M36, M36A2, M36C; Dump: M47, M59, M342A2· Maintenance, Earth Boring Machine and Pole Setter: V18A/MTQ, M764; Maintenance, Telephone Construction & Maintenance: V17A/MTQ; Pipeline Construction: M756, M756A2; Tank, Fuel Servicing, 1,200-Gal: M49, M49A1C, M49A2C, M49C; Tank, Water, 1,000-Gal: M50, M50A1, M50A2, M50A3; Tractor: M48, M275, M275A1, M275A2; Van, Expansible, M292, M292A1, M292A2, M292A5; Van, Shop: M109, M109A1, M109A2, M109A3; Wrecker, Crane: M108; and Wrecker, Light: M60
TM 9-2330-356-12&P	Direct Support and General Support Maintenance Manual Including Repair Parts and Special Tools List for Semitrailer, Tank: 5,000 Gallon, Bulk Haul, Self Load/Unload: M967 (NSN 2330-01-50-5632) and M967A1 (2330-01-155-0046); Semitrailer,

	Tank, 5,000 Gallon, Fuel Dispensing, Automotive, M969 (2330-01-050-5634) and M969A1 (2330-01-155-0048); Semitrailer, Tank, 5,000 Gallon Fuel Dispensing, Under/Overwing Aircraft, M970 (2330-01-050-5635) and M970A1 (2330-01-155-0047)
TM 9-2330-356-34&P	Direct Support and General Support Maintenance Manual Including Repair Parts and Special Tools List for Semitrailer, Tank: 5,000 Gallon, Bulk Haul, Self Load/Unload, M967 (NSN 2330-01-050-5632) and M967A1 (2330-01-255-0046); Semitrailer, Tank: 5,000 Gallon, Fuel Dispensing, Automotive, M969 (2330-01-050-5634) and M969A1 (2330-01-155-0048); Semitrailer, Tank: 5,000 Gallon, Fuel Dispensing, Under/Overwing Aircraft, M970 (2330-01-050-5635) and M970A1 (2330-01-155-0047)
TM 10-4510-201-14	Operator's, Organizational, Direct Support and General Support Maintenance Manual: Bath Unit, Portable, 8-Shower Head, M1958 (Orr & Sembower Model 8-SH-1, Army Model SPE35) (NSN 4510-00-679-6943); (York Shipley Model 8-SH-60, Army Model SPE35) (4510-00-806-9555), (Model 8-SH-62, Army Model SPE41) (4510-00-856-8610), (Model 8-SH-63, Army Model SPE44) (4510-00-994-9955), (Model YS49279) (4510-00-168-1930), (Model 8-SH-70-YS, Army Model SPE45) (4510-00-418-4774) and (Model YS74) (4510-01-003-0350)
TM 10-7200-200-13	Organizational and Direct Support Maintenance Manual (Including Repair Parts and Special Tools List): Can, Gasoline, Military, Steel, 5-Gallon (FSN 7240-222-3088); Can, Water, Military, Steel, 5-Gallon (7240-242-6153); Can, Water, Military, Aluminum, 5-Gallon (7240-242-3767); Can, Water, Military, Plastic; 5-Gallon (7240-089-3827) and Case, Military, Water Can (7240-125-9061)
TM 10-8110-201-14&P	Operator's, Organizational, Direct Support and General Support Maintenance Manual Including Repair Parts and Special Tools List for Drums, Fabric Collapsible, Non-Vented; 500 Gallon, Liquid Fuel, Part No. 13216E9172 (NSN 8110-00-753-4892); Part No. 10210E8.70 (8110-00-824-1444); 250 Gallon, Potable Water, Part No. 5-13-1881-1 (8110-00-900-8328) and 55 Gallon, Potable Water, Part No. 5-13-206-1 (8110-00-089-4505)

Section III. Prescribed Forms

DA Form 5456-R	Water Point Inspection. (Prescribed in para 5-7*b*.)
DA Form 5457-R	Potable Water Container Inspection. (Prescribed in para 7-8*b*.)
DA Form 5458-R	Shower/Decontamination Point Inspection. (Prescribed in para 8-6*b*.)
DD Form 686	Fluoride/Bacteriological Examination of Water. (Prescribed in para 5-13*a*(11).)

Section IV. Referenced Forms

DA Form 1712-R	Water Reconnaissance Report. (FM 10-52.)
DA Form 1713-R	Daily Water Production Log—Erdlator. (FM 10-52.)
DA Form 1713-1-R	Daily Water Production Log—ROWPU. (FM 10-52.)
DA Form 1714-R	Daily Water Distribution Log. (FM 10-52.)

Appendix B

Army Laboratories or Agencies and Areas Served

Laboratory or agency	*Area served*
Commander USAEHA Field Support Activity Fort George G. Meade, MD 20755-5225 AUTOVON 923-6205	Connecticut, Delaware, District of Columbia, Eastern Kentucky, Indiana, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia.
Commander USAEHA Field Support Activity Fort McPherson, GA 30330-5000 AUTOVON 588-3234	Alabama, Arkansas, Florida, Georgia, Western Kentucky, Louisiana, Mississippi, Oklahoma, Puerto Rico, South Carolina, Tennessee, Central and Eastern Texas.
Commander USAEHA Field Support Activity Fitzsimons Army Medical Center Aurora, CO 80045-5001 AUTOVON 943-8881	Alaska, Arizona, California, Colorado, Idaho, Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, West Texas, Utah, Washington, Wisconsin, Wyoming.
Commander U.S. Army Pacific Environmental Health Engineering Agency, Sagami APO San Francisco 96343 Ask overseas operator for: Camp Zama 228-4111	Hawaii, Japan, Korea, Okinawa, Philippines, Thailand, and all other Far East areas.
Commander Tenth Medical Laboratory ATTN: Preventive Medicine APO New York 09180 Ask overseas operator for: Gibbs Barracks in Landstuhl 2223-8203	Europe, Africa, and Southwest Asia.
Commander US Army Environmental Hygiene Agency ATTN: HSHB-EW Aberdeen Proving Ground, MD 21010-5422 AUTOVON 584-3816/3289/3919	Support to agencies and laboratory listed *and* areas not specified.

Appendix C

Equipment Cleaning, Sanitizing, and Decontaminating

C-1. General

a. Procedures for cleaning potable water purification, storage, and distribution equipment; nonpotable water containers; and liquid food product containers are presented in paragraph C-2. Procedures for cleaning fuel containers are presented in paragraph C-3. Procedures for sanitizing all types of equipment are presented in paragraph C-4. A list of the materials necessary for cleaning and sanitizing equipment is presented in table C-1. The unit field sanitation team will perform or supervise the cleaning and sanitizing procedures to ensure that the procedures are effective.

b. Procedures for decontaminating equipment are presented in paragraph C-5. Large-scale NBC decontamination operations are performed by the NBC defense company or detachment. Unit decontamination will be supervised by the unit NBC officer or noncommissioned officer.

C-2. Water and liquid food product container cleaning

a. Preparation.

(1) During noncombat emergencies when working in containers large enough to accommodate a person, workers will adhere to standards for working in confined spaces set by the National Institute for Occupational Safety and Health (NIOSH). These standards are presented in the DHEW (NIOSH) Publication No. 80-106.

(2) Remove rust from interior surfaces using scouring powder and a nonmetallic scouring pad or brush.

(3) Steam clean for at least 30 minutes (if possible) any liquid food product containers with residues of thickened liquids such as molasses, oils, or syrups.

(4) Thoroughly rinse the interior of the container and discard the contents.

(5) Prepare a soap solution by adding one-third canteen cup of dishwashing compound to 10 gallons (38 liters) of hot water *or* 3-1/3 canteen cups of dishwashing compound to 100 gallons (380 liters) of hot water.

b. Cleaning procedures.

(1) Thoroughly wash the interior surfaces of the equipment with the soap solution.

(*a*) For 5 gallon cans, add 1 gallon (3.8 liters) of the soap solution, shake vigorously for 1 minute, and drain.

(*b*) For larger containers, scrub the interior surfaces with a long-handled brush.

(*c*) Clean the filling and discharge pumps, pipes, valves, and spigots by drawing soap solution through them.

(2) Rinse the container and apparatus twice with warm (120 °F (49 °C) water to completely remove the soap solution.

(3) Drain the rinse water through the discharge apparatus and discard the rinse water.

c. Sanitizing requirement. After cleaning, sanitize the container with a 100 ppm chlorine solution as discussed in paragraph C-4.

C-3. Fuel container cleaning

a. Fuel containers. Fuel containers will only be used in support of extreme emergencies during combat when potable and nonpotable water containers are not available.

b. Container selection. If possible, select the containers that have been exposed to the least contamination and those with the fewest interior seams or interior surface imperfections. Interior seams and imperfections may harbor traces of contaminants and make effective cleaning and sanitizing difficult.

c. Safety Precautions. Tanks large enough to accommodate a person should be considered as confined spaces and workers should adhere to standards presented in the DHEW (NIOSH) Publication No. 80-106. If combat conditions do not permit adherence to the NIOSH standards, the following minimal protective measures should be taken to protect the health of the workers:

(1) Use oxygen deficiency and explosivity meters to continuously test for oxygen content and for harmful or explosive fuel vapors.

(2) The workers will use either a positive-pressure, self-contained breathing apparatus or a positive-pressure air line respirator with an auxillary self-contained air supply section 1910.134 (Respiratory Protection), title 29, Code of Federal Regulations (29 CFR 1910.134)). If an air line is used, the line should be fastened to the safety harness in such a manner that it will provide sufficient air but not be able to be pulled from the face mask or hood. Pure oxygen will not be supplied for respiration because of possible fire or explosion hazard; instead, the air should be supplied from an oilless air compressor.

(3) Fire or explosion should be guarded against by using spark-proof equipment only and wearing

composition-sole shoes free of nails. These precautions must be observed by workers inside and outside the tank.

(4) Protective clothing (such as rubber gloves, coveralls, and safety shoes with insulated rubber coverings) should be used to protect the worker against harmful liquids. After the work is completed, all equipment and clothing must be thoroughly cleaned of any residues. The worker should take a shower and put on clean clothes.

(5) Prior to and during entry, the confined space should be purged and ventilated with outside air using an explosion-proof ventilator.

(6) Interior work lights must be explosion proof.

(7) A fire extinguisher should be kept on hand.

(8) The worker should use a safety harness attached to a safety line before entering the tank. The safety line should be tied onto an immovable object outside of the tank. While in the tank, the worker must be kept constantly under the observation of two other workers, one of whom is equipped with a positive-pressure, self-contained breathing apparatus, outside of the tank. The worker inside the tank can signal trouble by tugging on the safety line, which should be held by one of the observers, at which time the observers can remove the worker from the tank. If necessary, artificial respiration should be administered and medical attention sought.

d. Preparation.

(1) Construct a seepage pit or sump into which all fuel residues, cleaning solutions, and rinse waters will be discharged. If a sanitary sewer manhole is available, discharge cleaning wastes into it. *Do not discharge fuel residues into a sanitary sewer.*

(2) Drain residual fuel or oil from the container.

(3) Thoroughly rinse the interior of the container and discard the contents.

(4) Remove rust from interior surfaces using scouring powder and a nonmetallic scouring pad or brush.

(5) Steam clean for at least 60 minutes (if possible) all fuel containers having a capacity of more than 25 gallons (95 liters).

(6) Thoroughly rinse the interior of the container and discard the contents.

(7) Prepare a soap solution by adding one-third of a canteen cup of dishwashing compound to 10 gallons (38 liters) of hot water *or* 3 1/3 canteen cups of dishwashing compound to 100 gallons (380 liters) of hot water.

e. Cleaning Procedures.

(1) 5-gallon cans.

(a) Add 1 gallon (3.8 liters) of the soap solution, shake vigorously for 5 minutes, and discard the contents.

(b) Rinse the can thoroughly with warm water (120 °F (49 °C)) and discard the contents.

(c) Add 3 messkit spoonfuls of powdered activated carbon, fill the can half full of water, shake vigorously for 5 minutes, and discard the contents.

(d) Rinse the can three times with warm water to remove the soap solution.

(e) Drain the rinse water and discard it.

(f) Limit storage of water in 5-gallon cans to 1 day. If odors occur in stored water, add 5 messkit spoonfuls of activated carbon to the can, shake vigorously for 5 minutes, and allow the carbon to settle for 10 minutes before drinking the water.

(2) Metal and collapsible fabric drums with a capacity of up to 600 gallons.

(a) Fill the drum one-third full with the soap solution, roll the drum for at least 15 minutes and discard the contents.

(b) Rinse the drum thoroughly with warm water (120 °F (49 °C)) and discard the contents.

(c) Add 1 canteen cupful of powdered activated carbon per 50 gallons (190 liters) of drum capacity, fill the drum one-third full of water, roll the drum for at least 15 minutes, and discard the contents.

(d) Rinse the drum three times with warm water to remove the soap solution.

(e) Drain the rinse water and discard it.

(f) Limit storage of water in drums to 1 week. If odors occur during that time, add 2 canteen cupfuls of powdered activated carbon per 50 gallons (190 liters) of drum capacity, roll the drum for 15 minutes, and allow the carbon to settle for 15 minutes before drinking the water.

(3) 1,200- and 5,000-gallon tank trucks.

(a) When sufficient quantities of water are available, use the following procedure:

1 Add 1 gallon (3.8 liters) of dishwashing compound via the top hatch for each 1,000 gallons of tank capacity.

2 Fill the tank approximately two-thirds full with fresh water.

3 Mix thoroughly the contents by driving the tank truck around the area for 30 minutes.

4 Fill the remaining volume with fresh water via the top manhole.

5 Agitate the contents of the tank further by recirculating the mixture through the pump and pipe manifold for 30 minutes.

6 Drain the contents through the pump to discharge.

7 Rinse the tank by spraying fresh water on all interior surfaces for 15 minutes.

8 Close the manifold valves and completely fill the tank with fresh water.

9 Recirculate the rinse water through the pump and manifold for 30 minutes.

10 Drain the contents through the pump to

discharge it.

(*b*) When quantities of water are limited, use this procedure:

1 Using the soap solution described in paragraph C-3*d*(7) above, scrub the interior surfaces with a long-handled brush.

2 Clean the pump and pipe manifolds by recirculating the soap solution for 30 minutes.

3 Drain the contents through the pump to discharge it.

4 Rinse the tank by spraying water on all interior surfaces for 15 minutes.

5 Recirculate the rinse water through the pump and pipe manifolds for 30 minutes, then discharge it.

6 Rinse the tanks twice more, each time drawing the rinse water through the pump and pipe manifolds for 30 minutes prior to discharge.

(*c*) After sanitizing the tank, using procedures in paragraph C-4 below, add 20 pounds (9 kg) of powdered activated carbon per 1,000 gallons (3800 liters) of tank capacity prior to filling the tank with potable water.

(*d*) Limit storage of water in the tank to 1 day.

(*e*) Flush the tank of residual activated carbon at the end of each day. Add new activated carbon at the beginning of the following day.

(*4*) *Collapsible fabric tanks.*

(*a*) Add 1 gallon (3.8 liters) of dishwashing compound per 1,000 gallons (3,800 liters) of tank capacity.

(*b*) Fill the tank with sufficient water to raise the height of the tank to 1 foot (30 cm).

(*c*) If the tank has only one filling and discharge port, use several personnel working in two shifts of 5 minutes each to walk on top of the tank for 30 minutes. Ensure the entire area of the tank has been walked upon.

(*d*) If the tank has two ports, use the distribution pump and hose to recirculate water through the tank for 30 minutes.

(*e*) Discharge the soap solution through the distribution pump, hose and nozzle; and completely drain the tank using the drain valve and hose assembly.

(*f*) Rinse the tank by filling it with sufficient water to raise the height of the tank to 1 foot (30 cm).

(*g*) Recirculate the rinse water in the tank for 30 minutes by using the distribution pump and hose, as appropriate.

(*h*) Discharge the rinse water through the distribution pump, hose, and nozzle; and completely drain the tank using the drain valve and hose assembly.

(*i*) Rinse the tank twice more, each time recirculating the water for 30 minutes prior to discharge.

(*j*) Drain the rinse water and discard it.

(*k*) Limit storage of water in collapsible fabric tanks to 1 day, if the situation permits.

C-4. Equipment sanitizing

a. General. All equipment used to store and distribute potable water will be sanitized with a 100 ppm chlorine solution after the equipment has been cleaned.

b. Preparation.

(1) Construct a seepage pit or sump into which the waste chlorine solution and rinse waters will be discharged. Waste chlorine solution should not be discharged into bodies of water or into sanitary sewers. The chlorine can kill aquatic organisms in the water and bacteria in sewage which are necessary for waste degradation.

(2) Prepare a sanitizing solution of 100 ppm chlorine.

(a) Using calcium hypochlorite, add 1 ampule to 1 gallon (3.8 liters) of potable water *or* add 5 level messkit spoonfuls to 100 gallons (380 liters) of potable water.

(b) Using liquid bleach, add 1 messkit spoonful to 1 gallon (3.8 liters) of potable water *or* add 1 gallon of bleach to 100 gallons (380 liters) of potable water.

c. Procedures.

(1) When sufficient quantities of water are available, fill the container with the sanitizing solution. Close the manhole covers or ports. Allow the solution to remain in the container for 60 minutes.

(2) If sufficient quantities of water are not available, apply the sanitizing solution by spraying or brushing (use a clean, nonmetallic brush) it on the interior surface to include ports and manholes. Add additional solution to the tank to clean the discharge and pumping apparatus. The solution must remain in contact with the surfaces for 60 minutes and may require reapplications of the solution every 10 minutes to keep surfaces wet.

(3) Rinse the equipment and apparatuses twice with potable water.

(4) Drain the rinse water through the discharge apparatus and appropriate distribution pumps, hoses, and nozzles.

(5) If the equipment is not to be used for a long period of time, open all ports and manholes, remove the drain plug (if any), and allow the equipment to dry.

(6) When dry, store the equipment per guidance in the appropriate technical manual (refer to app A).

C-5. Equipment decontamination

a. General.

(*1*) *Organized decontamination.* Large-scale NBC decontamination operations are performed by the NBC defense company or detachment as discussed in FM 3-87 (HTF).

(*2*) *Unit decontamination.* Unit decontamination will be supervised by the unit NBC officer or noncom-

missioned officer. Decontamination procedures are discussed in TM 3-220.

b. Field expedient decontamination. Water purification and supply personnel and unit field sanitation teams regularly work with an effective chemical and biological agent decontaminant, calcium hypochlorite. This chemical can be used for decontamination of equipment surfaces by following the procedures described below.

(*1*) *Preparation.*

(*a*) Construct a soakage pit or sump into which the decontamination waste and rinse water can be discharged.

(*b*) Wear personal protective equipment and prepare a 3 percent solution of chlorine by adding 3 canteen cups of calcium hypochlorite to 6 gallons (23 liters) of water.

(*2*) *Procedures.*

(*a*) Apply the solution to the exterior of the equipment or container using brushes or brooms. One gallon (3.8 liters) of the solution should cover 8 square yards (7 square m). The decontamination solution must remain in contact with the surface for at least 30 minutes and may have to be reapplied occasionally to keep the surface wet.

(*b*) Thoroughly wash the surface with water.

(*c*) Test the water stored in containers with the M272 kit to determine if the water was contaminated. If not, rechlorinate the water to 5 ppm or at a higher level if prescribed by the command surgeon.

(*d*) If the water is contaminated with a detectable level of chemical agent which exceeds the standards in table 3-1, water purification sections should retreat the water using appropriate methods described in FM 10-52, chapter 6, section III. Units should procure a new supply of potable water from quartermaster supplies.

Table C-1. Nomenclature for ordering equipment cleaning and sanitizing supplies

NSN identifier	Item
7920-00-061-0038	Brush, Scrub, Plastic *Item used to scrub the interior surfaces of water purification, storage, and distribution equipment.*
7920-00-753-5242	Pad, scouring, type II, 6 in. by 9-1/2 in. by 1/4 in.
7930-00-205-0442	Scouring Powder, 14 oz. can *Item used to clean steel and aluminum surfaces of water purification, storage, and distribution equipment.*
7930-00-899-9534	Dishwashing Compound, 5 gal bottle *Item used to prepare a soap solution for cleaning equipment.*
6810-00-242-4770	Calcium Hypochlorite, Technical, 3-3/4 lb bottle
6810-00-255-0471	Calcium Hypochlorite, Technical, 6 oz bottle
6810-00-255-0472	Calcium Hypochlorite, Technical, 100 lb drum
6810-00-598-7316	Sodium Hypochlorite, 5 gal bottle
6850-00-270-6225	Chlorination Kit, Water Purification *Item used to disinfect water and to prepare a sanitizing solution for equipment.*
6810-00-264-5896	Carbon, Activated, Technical, 10 lb pail
6810-00-264-6575	Carbon, Activated, Technical, 50 lb drum *Item used to neutralize bad tastes and odors in water.*

Appendix D

Waterborne Diseases

D-1. General

This appendix presents a short discussion of waterborne diseases of special concern to units participating in field training exercises or deployed in contingency operations. A complete discussion of these and other diseases is provided in FM 8-33.

D-2. Role of water in diseases

Water is a carrier of many organisms which cause intestinal disease. An epidemic of one of these diseases among Army troops can be more devastating than enemy action and can cause great damage to morale as well as health. A heavy responsibility thus rests upon water purification personnel and the unit field sanitation team to maintain proper disinfectant residuals. The types of water treatment methods to be used when certain chlorine-resistant organisms are encountered should be prescribed by the command surgeon who can recognize or anticipate the presence of these organisms. The command surgeon will recommend such additional chlorination or other treatment methods as may be necessary.

D-3. Microbiological contamination of raw water sources

In addition to the native water bacteria, a given water may and usually does contain a variety of bacteria as a result of contamination from external sources. These sources include the air, soil, and human and animal excreta. The number of bacteria in the air bears a close relation to the quantity of larger suspended particles or dust. The kinds of microorganisms vary somewhat in different localities, but certain forms are generally present. Molds and yeasts are quite common and may outnumber the bacteria. Soils may contain tremendous numbers of bacteria, most of which are found in the upper 6 inches of soil. Most of these microorganisms are native to the soil and their biochemical activities are important to the mechanism of decomposition of organic matter in the soil. Bacteria other than those which make up the normal flora of the soil may be present as contamination. Any pathogens present may be regarded as originating from one of two sources: the flesh of animals or persons who have died of infectious disease and the excreta of infected persons or animals.

D-4. Examples of waterborne diseases of concern to the military

a. Diarrhea. Acute diarrhea caused by campylobacter, certain strains of *Escherichia coli* which produce toxins, or some noncholera vibrios constitute the majority of travelers' diarrhea cases worldwide. They may be spread by food or other routes as well as by water. The acute onset of diarrhea, abdominal pain, often nausea, vomiting and fever occurs after an incubation period of about 2 to 5 days. The acute illness is usually limited to 3 to 5 days or less. Diagnosis is made by isolation of organisms from stool, using tests to demonstrate toxins, special media, or other techniques.

b. Cholera. Cholera is caused by an enterotoxin produced by the bacillus *Vibrio cholerae*. Although mild cases exhibiting diarrhea are common, acute cases can result in death within a few hours if untreated. This intestinal disease produces profuse watery stools, occasional vomiting, rapid dehydration, and circulatory collapse. Diagnosis is confirmed by culturing O-group 1 cholera vibrios from feces or vomitus. Cholera occurs mainly in Asia, Africa, and parts of the Mediterranean. The incubation period lasts from a few hours to 5 days and is usually 2 to 3 days. Infectivity continues until a few days later after recovery though a carrier state may persist for several months. Susceptibility is variable and in endemic areas most persons acquire antibodies by early adulthood. Partial active immunity is conferred for 3 to 6 months by current vaccines.

c. Typhoid. Typhoid fever, the best studied enteric fever, is a severe prolonged disease with a high rate of complications. It is characterized by sustained fever, headache, malaise, anorexia, enlargement of the spleen, a nonproductive cough, constipation, and involvement of lymphoid tissues. Caused by the bacillus *Salmonella typhi*, typhoid occurs worldwide. The period of incubation usually lasts 1 to 3 weeks. Infectivity continues from the first week through convalescence. Susceptibility is general.

d. Amebiasis. Amebiasis is caused by a protozoan, *Entamoeba histolytica*. This protozoan may be acquired via the infective cyst which is passed in the feces. Although most cases are asymptomatic, acute cases exhibit fever, chills, and bloody diarrhea. Diagnosis is by microscopic detection of cysts or trophozoites in fresh fecal specimens. Occurrence is world-

wide. The incubation period is commonly 2 to 4 weeks. Infectivity continues through the period of cyst passing, which may last several years. Susceptibility is general.

e. Giardiasis. Giardiasis, another protozoan infection, principally affects the upper small intestine. As with amebiasis, most cases are asymptomatic. After an incubation period of 7 to 21 days, acute cases may present abdominal cramps, flatulence, diarrhea, fatigue, and weight loss. If untreated, passage of cysts may continue for 3 months or, rarely, longer. Diagnosis is usually made by microscopic detections of cysts or trophozoites in fresh fecal specimens. In doubtful cases, the diagnosis can be made by examining upper intestinal fluid or biopsy obtained by special procedures.

f. Shigellosis. Known also as bacillary dysentery, shigellosis is an acute bacterial disease primarily involving the large intestine. It is characterized by diarrhea accompanied by fever, nausea, and sometimes vomiting. The severity of the illness is a function of the age of the patient, preexisting state of nutrition, the size of the infecting dose, and the serotype of the organism. Bacteriological diagnosis is by isolation of *Shigella* from feces or rectal swabs. Shigellosis is endemic in both tropical and temperate climates. The incubation time is 1 to 7 days. Persons infected remain capable of spreading the disease until *Shigella* are no longer present in the feces, usually within 4 weeks of the illness. Susceptibility is general.

g. Infectious hepatitis. Caused by hepatitis A virus, infectious hepatitis ranges from a mild illness lasting 1 to 2 weeks to a severely disabling disease lasting several months. The onset of the symptoms is abrupt with fever, malaise, anorexia, nausea, and abdominal discomfort, followed by jaundice. Diagnosis is established by the demonstration of virus in the stool, or a fourfold or greater rise in specific antibodies. Infectious hepatitis occurs worldwide and tends toward cyclic recurrences. The incubation period is from 15 to 50 days and most commonly from 28 to 30 days. Maximum infectivity occurs during the later half of the incubation period until after the first week of jaundice. Susceptibility is general.

h. Schistosomiasis.

(1) Three human blood flukes, *Schistosoma mansoni*, *S. japonicum*, and *S. haematobium*, are the major species which cause human disease. Each of these species has a specific geographic distribution. *S. mansoni* occurs in southwest Asia, Africa, South America, and the Caribbean; *S. japonicum* in Japan, China, and the Philippines; and *S. haematobium* in Africa and southwest Asia. Two major factors are responsible for the endemicity of schistosomiasis in specific geographic areas: the presence of the specific snail intermediate host and the lack of sanitary disposal of human feces. After maturation within the body, adult flukes can cause intestinal or urinary tract complications. Diagnosis depends upon detection of eggs in the stool, urine, or biopsy specimen. The incubation period lasts 4 to 6 weeks after infection. The period of infectivity lasts as long as the person discharges eggs in feces or urine, up to 10 years or longer. Susceptibility is general.

(2) Schistosome dermatitis, or swimmer's itch, is caused by the larvae of certain schistosomes of birds or mammals which may penetrate the human skin and cause a dermatitis. These organisms do not enter the blood stream or cause other systemic effects. Such infections may occur among bathers in lakes in many parts of the world including the Great Lakes region of North America and certain coastal beaches.

Appendix E

Measurement of Chlorine Residual and pH

E-1. General

There are presently three methods available for measuring chlorine residual in field water supplies. These methods are the orthotolidine arsenite (OTA) tablets with plastic yellow-banded tubes, the OTA color comparator, and the N, N-diethyl-p-phenylenediamine (DPD) color comparator.

E-2. OTA tablet procedures

The color comparison tube procedures are outlined in FM 21-10, appendix A, task 5.

CAUTION

Color bands will fade if exposed to sunlight; store them in a cool, dark place. Keep the OTA tablet bottle tightly capped. Discard old tablets and tubes when a new kit is opened.

E-3. OTA color comparator procedures

The OTA color comparator is no longer authorized; however, several kits remain in the system. Procedures for use of the OTA color comparator are outlined in TM 5-6630-215-12, paragraph 2-22*e*(1). These OTA comparators will be modified to use the DPD residual method by ordering a new DPD color disk and DPD No. 1 tablets identified in table E-1.

E-4. DPD color comparator procedures

a. Wallace and Tiernan Model U25337.

(1) Place the DPD chlorine color comparator disc in the comparator.

(2) Select two clean comparator sample tubes.

(3) Fill one cell to the 15 mL mark with test water.

(4) Insert the cell into the *right hand* cell compartment of the comparator. This cell, when filled, to the mark, compensates for color and turbidity. The omission of this step may cause serious errors.

(5) Collect just enough test water to cover the bottom of the second sample cell.

(6) Add two DPD No. 1 Tablets to the second sample cell and crush them with the stirring rod. Fill the sample cell to the 15 mL mark with test water and insert it into the *left hand* cell compartment of the comparator.

(7) Hold the comparator close to your eye and face a good light source (daylight, but not the direct rays of the sun; daylight illuminator; or artificial light

Table E-1. Nomenclature for ordering equipment kits

NSN identifier	Item
6630-01-115-5281	Disk, Color Standard, Free Chlorine, DPD Method, Wallace & Tiernan Company *Item used to modify the existing comparator, NSN 6630-00-087-1838. The kit consists of one color disk for use with DPD reagent, a revised instruction book, a revised plastic-inclosed instruction card, and an instruction sheet on the steps to be taken to modify the existing comparator.*
6630-01-044-0334	Comparator, Color, Hydrogen Ion and Residual Chlorine, Wallace & Tiernan Company *Item used in performing pH and chlorine determinations of water in the field. The kit consists of one color comparator with prismatic eyepiece assembly, four rectangular sample cells, one pH reagent bottle, one DPD chlorine color disk, one pH color disk, operating instructions, service data and carrying case. Replacement item for NSN 6630-00-087-1838.*
6630-01-027-3914	Comparator, Color, Hydrogen Ion and Residual Chlorine, LaMotte Chemical Products Co. *Item used in performing pH and chlorine determinations in the field. The kit contains two chlorine comparator blocks, one pH comparator block, sample tubes, pH and DPD No. 1, No. 2, No. 3, and No. 4 tablets.*
6810-00-087-2340	pH indicator solution *Item used to measure pH when used with pH color disk.*
6810-01-044-0315	Chlorine Test Tablet, DPD Method, 100's, Wallace & Tiernan Company *Item used with NSNs 6630-01-027-3914 and 6630-01-044-0334, Comparator, to determine chlorine content in water. Item consists of 100 foil wrapped DPD No. 1 tablets.*
6640-00-926-2236	Dropper bottle, pn 893.
6850-00-270-6225	Chlorination Kit, Water Purification *Item used by field sanitation team to add calcium hypochlorite to water supplies and to test free chlorine residual with OTA tablets in plastic tubes with color bands. Item consists of 100 glass ampules of calcium hypochlorite, three plastic color-banded tubes which indicate chlorine residuals of 1, 5, and 10 mg/L, and three bottles of orthotolidine testing tablets.*

reflected from a white surface). Be sure your fingers do not cover the light window in the back of the comparator. Rotate the chlorine color comparator disk until a color on the disk matches the color of the indicator (left) tube. The reading can be made directly from the round window in front of the comparator. The value is expressed in ppm.

(8) Color matching will be completed as soon as possible after the addition of the DPD tablets. The reading should be made within 1 minute; delays of 2 minutes or more can produce incorrect results.

(9) If the color of the indicator tube is between two colors on the chlorine color comparator, the value will be estimated. Choose a value between the readings corresponding to the colors on either side of the indicator color.

(10) When the test has been completed, remove sample cells from the comparator, empty the samples and wash the cells with clean water.

b. LaMotte-Palin Model LP-8.

(1) Select one clean comparator sample tube.

(2) Rinse the sample tube with part of the test sample, then fill the tube to the mark with sample water.

(3) Add one DPD No. 1 Tablet to the test tube and crush the tablet with a glass rod.

(4) Cap the test tube and shake to dissolve the tablet.

(5) Immediately insert the test tube into the comparator.

(6) Hold the comparator about 1 foot away and face a good light source. Match the color of the sample with the color standards in the comparator. Read the value which is expressed in ppm.

(7) Follow steps (8) through (10) in E-4*a* above.

E-5. Precautions

a. General. As with all chemicals, caution should be exercised in handling OTA and DPD tablets. To ensure the greatest accuracy, follow the precautions listed below—

(*1*) *Cleanliness.*

(*a*) Before taking readings be sure that the color standards in the disk and the plastic tubes are clean.

(*b*) When taking samples, adding tablets, and mixing in the sample tubes, be sure that your hands are free of all traces of chemical so that the sample will not be contaminated. Any contamination of the samples will produce erroneous readings.

(*2*) *Color and turbidity.* To eliminate errors due to natural color and turbidity of the sample, make sure that water is added to the right-hand tube before making the color comparison.

(*3*) *Sunlight.* Do not allow direct sunlight to fall on the samples being tested. Sunlight causes the color developed by the tablet to fade.

b. Sample tubes. Color disks are adjusted for sample tubes having a 26-mm depth and on the basis of 15 mL of water sample. The graduated mark on the sample tubes is at 15 mL.

E-6. pH determinations

a. Wallace and Tiernan procedure. The pH is measured using the procedure described in paragraph E-4*a* except that—

(1) The second sample cell is filled to the 15 mL mark.

(2) One dropper full (0.5 mL) of pH indicator solution is substituted for the appropriate DPD tablet.

(3) The pH disk is used instead of the chlorine color disk.

b. LaMotte-Palin procedure. The LaMotte-Palin Phenol Red Indicator Tablet contains Halidex that eliminates the bleaching effect of chlorine or bromine on the pH indicator disk. No additional treatment is required when the halogen level is below 8.0 ppm.

(1) Rinse the test tube with the sample, then fill it to the mark.

(2) Add one LaMotte-Palin Phenol Red Indicator Tablet, cap, and gently shake to dissolve.

(3) Immediately insert the tube into the comparator to obtain a color match. If the test sample color is in between two standard colors, the midpoint between the two standard values is taken as the value of the sample.

E-7. Equipment

If new equipment kits are needed or available equipment is not adequate, replacement chlorine residual kits should be ordered using the information in table E-1.

Glossary

Section I. Abbreviations

AR	Army regulation
CONUS	continental United States
DHEW	Department of Health, Education, and Welfare
DPD	N,N-diethyl-p-phenylenediamine
EPA	Environmental Protection Agency
FAWPSS	Forward Area Water Point Supply System
FM	field manual
HOCl	hypochlorous acid
IMA	installation medical authority
gpd	gallons per day
gph	gallons per hour
MEDCEN	U.S. Army medical center
MEDDAC	U.S. Army Medical Department activity
mg/L	milligrams per liter
mL	milliliter
MOPP	mission-oriented protection posture
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological, and chemical
NIOSH	National Institute for Occupational Safety and Health
NSN	national stock number
NTU	nephelometric turbidity unit
OCl^-	hypochlorite ion
OCONUS	outside continental United States
OTA	orthotolidine arsenite
ppm	parts per million
PVNTMED	preventive medicine
QSTAG	quadripartite standardization agreement
ROWPU	reverse osmosis water purification unit
SOP	standing operating procedure
STANAG	standardization agreement
TB MED	technical bulletin (medical)
TB	technical bulletin
TC	training circular
TDS	total dissolved solid(s)
TM	technical manual
TOE	table of organization and equipment
USAEHA	United States Army Environmental Hygiene Agency

Section II. Terms

Acclimitization
The process by which a person becomes accustomed to new environmental conditions.

Command surgeon
The brigade surgeon, division surgeon, or corps surgeon responsible for provision of medical support at the brigade, division, or corps concerned.

Dehydrate
To lose water from body tissues.

Disinfection
The act of inactivating the larger portion of microorganisns in or on a substance with the probability that all pathogenic bacteria are killed by the agent used.

Endemic
A disease or organism that is constantly present to a greater or lesser extent in a particular locality or region.

Field water supply system
An assemblage of collection, purification, storage, transportation, and distribution equipment and personnel which provide potable water to field units during training and combat environments.

Free available chlorine
The chlorine equilibrium products present in the forms of hypochlorous acid (HOCl) and hypochlorite ions (OCl^-).

Fresh water
Fresh water has a TDS concentration of less than 1,500 ppm. Brackish waters are highly mineralized and have a TDS concentration between 1,500 ppm and 15,000 ppm. Saltwaters have a TDS concentration greater than 15,000 ppm.

Host
A living animal or plant in which a pathogenic organism grows.

Incubation period
The time required between infection by a pathogenic organism and the appearance of the signs of a disease.

Installation medical authority
The unit surgeon, command chief surgeon, MEDDAC and/or MEDCEN commanders, and the director of health services or his or her representative responsible for provision of medical support at the unit, command, or installation concerned.

LC Team
The TOE designation for an environmental engineering service team.

Maximum contaminant level
The maximum permissible level of a contaminant in water as delivered to the consumer.

Nonpotable water
Fresh or seawater that has not been treated or disinfected and has not been approved for human consumption.

Palatable water
Water that is pleasing in appearance and taste. It is significantly free from color, turbidity, taste, and odor. Also, it is cool and aerated. Palatable water may not be potable.

Pathogenic organism
Any disease-producing organism.

Pollution sources
Sources of pollution such as landfills, industrial and domestic sewage discharges, and fuel oil storage sites.

Potable water
Water that is free from disease-producing organisms, poisonous substances, and chemical or biological agents and radioactive contaminants which make it unfit for human consumption and many other uses. Potable water may or may not be palatable.

Treated water
Water that has undergone processing such as sedimentation, filtration, and disinfection. Does not imply potability until inspected by PVNTMED personnel and approved by the command surgeon.

Vector
An insect or other organism that carries and transmits a pathogenic amoeba, bacterium, fungus, virus, or worm.

Water quality
The chemical, physical, radiological, and microbiological characteristics of water with respect to its suitability for a particular purpose.

The proponent agency of this bulletin is the Office of The Surgeon General. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to HQDA (DASG–PSP), 5111 Leesburg Pike, Falls Church, VA 22041–3258.

By Order of the Secretary of the Army:

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The Adjutant General

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WATER POINT INSPECTION *For use of this form see TB MED 577; the proponent of this form is the Office of The Surgeon General.*		REPORT DATE
TO	FROM	
INSPECTION RATING	WATER POINT NO	MAP COORDINATE LOCATION
OPERATING UNIT	TEAM CHIEF	UNIT REPRESENTATIVE
INSPECTING UNIT	DATE/TIME GROUP	INSPECTED BY

INSPECTION CHECKLIST CRITERIA

		YES	NO
1. SITE CONDITIONS	a. Adequate Drainage		
	b. Dust Control Practiced		
	c. Rodent/Insect Control Practiced		
2. BIVOUAC AREA	a. ≥ 100 Ft Away/Downstream		
	b. Latrines ≥ 100 Yds Away		
	c. Handwashing Devices Present		
	d. Garbage Control Practiced		
3. WATER SOURCE	a. No Pollution Nearer Than 2 Miles		
	b. Chemical Agents Present		
	c. Radioactivity Present		
4. INTAKE LINE	a. Intake Strainer Attached		
	b. ≥ 4 In From Surface or Bottom		
5. EFFLUENT LINE	a. Backwash Water Sump Present		
	b. Sludge Sump Present		
	c. Discharge ≥ 25 Yds From Intake		
6. ERDLATOR	a. Trailer/Truck Level		
	b. Coagulator Weir Level		
	c. D-E Filter Pressures Maintained		
	d. Grounding Present		
7. ROWPU	a. Trailer/Pallets Level		
	b. Filter Backwash Tank Full		
	c. Grounding Present		
	d. Separate Storage Tanks Used for Raw and Brine Waters		
8. GENERATOR	a. Grounding Present		
	b. Fire Extinguisher Present		
	c. Hearing Protection Used		
	d. Sufficient Ventilation		
9. OPERATOR PROTECTION	a. Rubber Hip Boots Used		
	b. Long Rubber Gloves Used		
10. OPERATOR MONITORING	a. WQAS-E Chemicals Not Expired		
	b. Water Source Tested		
	c. Treated Water Tested		
	d. Chemical Usage Recorded		
	e. Gauge/Meter Readings Recorded		
	f. Chlorine Residuals Checked Hourly		

WATER POINT INSPECTION		YES	NO
11. WATER STORAGE	a. Tanks Level		
	b. Safety Bottom Apron Used		
	c. Open Top Tanks Covered		
	d. Tanks Clean and Sanitary		
	e. Capacity Sufficient for Issue		
12. WATER DISTRIBUTION	a. Standpipe Hose $\geq$ 4 Ft Above Ground		
	b. Hose Nozzle Clean/Off Ground		
	c. Operators Check Containers for Cleanliness		
13. RECORDS	a. Production Log Maintained		
	b. Distribution Log Maintained		
	c. Blank Forms Sufficient		
14. SUPPLY STORAGE	a. Fuel and Chemicals Sufficient		
	b. Chemical Containers Labelled/Capped/Dry		
	c. Activated Carbon & Calcium Hypochlorite Stored Separately		
15. PRODUCT WATER SAMPLE	a. Chloride ($\leq$ 600 mg/L)		
	b. Chlorine Residual Adequate (___ ppm)		
	c. Color ($\leq$ 50 Units)		
	d. Hardness (Magnesium $\leq$ 150 mg/L)		
	e. pH (Between 5 and 9 Units)		
	f. Sulfate ($\leq$ 400 mg/L)		
	g. TDS ($\leq$ 1500 mg/L)		
	h. Turbidity ($\leq$ 5 NTU)		
	i. Chemical Agents Present		
	j. Radioactivity Present		
	k. Coliforms ($\leq$ 1/100 mL); Results on DD Form 686		

COMMENTS AND RECOMMENDATIONS:

PRINTED/TYPED NAME AND GRADE OF PVNTMED INSPECTOR:	SIGNATURE:

POTABLE WATER CONTAINER INSPECTION *For use of this form see TB MED 577; the proponent of this form is the Office of The Surgeon General.*	REPORT DATE
TO	FROM

INSPECTION RATING	SERIAL NUMBER	MAP COORDINATE LOCATION
OWNING UNIT	MAINTENANCE NCO	UNIT REPRESENTATIVE
INSPECTION UNIT	DATE/TIME GROUP	INSPECTED BY

SECTION I. WATER TRAILER INSPECTION CRITERIA

		YES	NO
1. CONTAINER EXTERIOR	a. Marked "POTABLE WATER ONLY"		
	b. Clean/Good Repair		
2. MANHOLE COVERS	a. Rubber Gasket Intact		
	b. Locking Mechanism Functions		
	c. No Rust/Insulation Intact		
	d. Pressure Relief Valve Operates		
3. DISPENSING SPIGOTS	a. All Spigots Function		
	b. "T" Handle Operates Easily		
	c. Protective Box Intact		
	d. Locking Devices Function		
4. DRAIN	a. Plug Installed Hand-Tight		
	b. Cracks Do Not Expose Fiberglass		
	c. Plug/Hole Threads Undamaged		
	d. Threads Not Rusted		
5. CONTAINER INTERIOR: STAINLESS STEEL AND ALUMINUM	a. Clean/Good Repair		
	b. No Rust		
	c. Not Painted/Coated		
	d. No Cracks/Dents Exposing Polyurethane Foam		
6. CONTAINER INTERIOR: FIBERGLASS	a. Clean/Good Repair		
	b. Cracks/Chips Less Than 10%		
	c. Fiberglass Exposed		
	d. Paint Surface Not Flaking		

SECTION II. WATER TANK TRUCK INSPECTION CRITERIA

1. CONTAINER EXTERIOR	a. Marked "POTABLE WATER ONLY"		
	b. Clean/Good Repair		
2. MANHOLE COVERS AND FILLING PORTS	a. Rubber Gaskets Intact		
	b. Locking Mechanisms Function		
	c. No Rust/Insulation Intact		
3. DISPENSING VALVES	a. Valves Operate Easily		
	b. Hose Coupling Threads Undamaged		
	c. Dust Caps Attached to Valve Ports		
4. TANK INTERIOR	a. Clean/Good Repair		
	b. No Rust		
	c. Steel/Aluminum Not Painted		

SECTION III. FABRIC TANK/DRUM INSPECTION CRITERIA

		YES	NO
1. CONTAINER EXTERIOR	a. Marked "POTABLE WATER ONLY"		
	b. Clean/Good Repair		
	c. Plugs/Patches Secure		
2. VALVE ASSEMBLY	a. Check-Valve Adapter Undamaged		
	b. Coupler Valve Operates Easily		
	c. Dust Cap Attached to Coupler		

SECTION IV. CONTAINER LOCATION (FIELD USE) INSPECTION CRITERIA

1. SITE CONDITIONS	a. Manholes/Ports Closed		
	b. Soakage Pits Constructed Beneath Spigots		
2. WATER CONDITIONS	a. Chlorine Residual Adequate (___ ppm)		
	b. Procured From: _____		

COMMENTS AND RECOMMENDATIONS:

PRINTED/TYPED NAME AND GRADE OF PVNTMED INSPECTOR:	SIGNATURE:

SHOWER/DECONTAMINATION POINT INSPECTION *For use of this form see TB MED 577; the proponent of this form is the Office of The Surgeon General.*		REPORT DATE
TO	FROM	
INSPECTION RATING	SHOWER POINT NO	MAP COORDINATE LOCATION
OPERATING UNIT	TEAM CHIEF	UNIT REPRESENTATIVE
INSPECTING UNIT	DATE/TIME GROUP	INSPECTED BY

INSPECTION CHECKLIST CRITERIA

		YES	NO
1. SITE CONDITIONS	a. Adequate Drainage		
	b. Rodent/Insect Breeding Areas Controlled		
	c. Separate Latrines Provided		
	d. Latrines Adequate (___Men/___Women)		
	e. Handwashing Devices Present		
	f. Garbage Control Practiced		
2. WATER SOURCE	a. Nonpotable Water Chlorinated		
	b. Chemical Agents Present		
	c. Radioactivity Present		
	d. Procured From: _____		
3. WASTEWATER CONTROL	a. Drainage Ditches Adequate		
	b. Effluent Discharge ≥ 25 Yds Downstream		
	c. Decontamination Waste Sump Present		
	d. Proper Sump Closeout and Marking		
4. INTAKE LINE	a. Intake Strainer Attached		
	b. ≥ 4 In From Surface or Bottom		
5. SHOWER UNIT	a. Showers/Floor Clean		
	b. Air Circulation Provided		
	c. Nonpotable Water Sign Posted		
6. GENERATOR	a. Located ≥ 50 Ft From Showers		
	b. Grounding Present		
	c. Fire Extinguisher Present		
	d. Hearing Protection Used		
	e. Sufficient Ventilation		
7. OPERATOR MONITORING	a. Chlorine Residuals Checked		
	b. Chemical Agents Present		
	c. Radioactivity Present		
	d. Shower Water Temperature Checked		
8. WATER STORAGE	a. Tanks Level		
	b. Safety Bottom Apron Used		
	c. Open Top Tanks Covered		
	d. Tanks Clean and Sanitary		
	e. Capacity Sufficient for Issue		

INSPECTION CHECKLIST CRITERIA		YES	NO
9. RECORDS	a. Bath and Clothing Exchange Report Used		
	b. Blank Forms Sufficient		
10. SUPPLY STORAGE	a. Fuel and Chemicals Sufficient		
	b. Chemical Containers Labeled/Capped/ Dry		
	c. Activated Carbon and Calcium Hypochlorite Stored Separately		
11. SHOWER WATER SAMPLES	a. Chlorine Residuals Checked		
	b. Chemical Agents Present		
	c. Radioactivity Present		
	d. Shower Water Temperature Checked		

COMMENTS AND RECOMMENDATIONS:

PRINTED/TYPED NAME AND GRADE OF PVNTMED INSPECTOR:	SIGNATURE:

PIN: 058770-000